



LEVEL 1

AD

2

AMSAA

TECHNICAL REPORT NO. 313

THE EFFECT OF CHEMICAL PROTECTIVE CLOTHING
AND EQUIPMENT ON COMBAT EFFICIENCY

JOHN A. RAKACZKY

NOVEMBER 1981

DTIC
ELECTE
DEC 15 1981

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

U.S. ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY
ABERDEEN PROVING GROUND, MARYLAND

AD A108575

DISPOSITION

Destroy this report when no longer needed. Do not return it to the originator.

DISCLAIMER

The findings in this report are not to be construed as an official Department of the Army position unless so specified by other official documentation.

WARNING

Information and data contained in this document are based on the input available at the time of preparation. The results may be subject to change and should not be construed as representing the DARCOM position unless so specified.

TRADE NAMES

The use of trade names in this report does not constitute an official endorsement or approval of the use of such commercial hardware or software. The report may not be cited for purposes of advertisement.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Technical Report No. 313	2. GOVT ACCESSION NO. AD-A108575	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) The Effect of Chemical Protective Clothing and Equipment on Combat Efficiency.		5. TYPE OF REPORT & PERIOD COVERED Apr 80 - Jul 81
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) John A. Rakaczky		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Materiel Systems Analysis Activity Aberdeen Proving Ground, MD 21005		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS DA Project No. 1R665706M541
11. CONTROLLING OFFICE NAME AND ADDRESS Commander, US Army Materiel Development and Readiness Command, 5001 Eisenhower Avenue, Alexandria, VA 22333		12. REPORT DATE November 1981
		13. NUMBER OF PAGES 87
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release, distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Chemical Warfare (CW) Individual Protection NBC Defense War games Degradation Modeling Mission Oriented Protective Posture		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A need exists for specific, quantitative data pertaining to the degradation of individual and unit combat efficiency caused by the wearing of chemical warfare (CW) protective gear, i.e., mask, hood, gloves, overgarment, and overboots. The US Army Materiel Systems Analysis Activity (USAMSAA) has initiated a program designed to provide these data. This report describes the first portion of this program, the development of a viable data base which will enable meaningful and useful degradation data to be generated through the employment of computer simulations.		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

PREFACE

Computer simulations are used to evaluate doctrine, training procedures, equipment and occasionally to study current battlefield scenarios. In any future conflict there is the strong possibility that toxic chemical agents will be employed by opposing forces to achieve a tactical advantage. As a result, computer models are being modified or developed to study the effects that chemical warfare will have on military operations.

Among the duties and responsibilities of the Tactical Operations Analysis Division (TOAD) of the US Army Materiel Systems Analysis Activity (AMSAA) is the formulation, development, revision, or refinement of computer simulations, i.e., war games. One of the major areas of interest in a chemical warfare scenario, and which is addressed in very few of the current models, is the degradation of personnel efficiency resulting from the necessity to wear chemical warfare protective gear. To accurately and realistically evaluate the effects of degradation through modeling, a viable data base is a primary requirement to develop and/or validate a reliable model. AMSAA is attempting to develop this data base.

A draft interim note detailing the initial effort was distributed on a limited basis in mid-January 1981, along with a letter soliciting comments, criticism, guidance, data, etc. Responses received from this request have been incorporated, to the extent possible at this time, into the current report. Distribution of this report has been considerably wider than that of the draft interim note. As before, a request has been made for comments and suggestions, but the primary interest is in acquiring quantified data that is more recent, more reliable, and that more realistically reflect plausible combat conditions.

Information received will be incorporated into a revised report which is tentatively planned for mid-1982. AMSAA POC is John Rakaczky, DRXSY-TN, Autovon 283-4485, Commercial (301)-278-4485.

Previously distributed copies of the draft interim report dated 19 January 1981 should be destroyed.

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

ACKNOWLEDGEMENTS

The US Army Materiel Systems Analysis Activity (AMSAA) wishes to recognize Joe A. Swisher, Dennis F. Metz, Walter J. Swiderski, and Richard Kaste for their contributions to this report.

In addition, AMSAA wishes to recognize the contributions of the many officers at APG who participated in the construction of the tables listing the functions of the various Army branches, and particularly to CPT Andrew W. Knight, USATECOM, APG, MD, who prepared the entire table of Quartermaster functions and times.

TABLE OF CONTENTS

	Page
PREFACE	3
ACKNOWLEDGEMENTS.	4
LIST OF TABLES.	7
1. INTRODUCTION.	9
2. APPROACH/RATIONALE.	11
3. RESULTS AND DISCUSSION.	13
4. SUMMARY	71
5. FURTHER EFFORTS/RECOMMENDATIONS	73
REFERENCES.	75
DISTRIBUTION LIST	79

LIST OF TABLES

<u>Table No.</u>	<u>Page</u>
1. Definition of MOPP Levels	10
2. Performance Degradation Data for Air Defense Units in a Chemical Warfare (CW) Environment	15
3. Performance Degradation Data for Armor Units in a Chemical Warfare (CW) Environment	18
4. Performance Degradation Data for Artillery Units in a Chemical Warfare (CW) Environment	22
5. Performance Degradation Data for Aviation Units in a Chemical Warfare (CW) Environment	25
6. Performance Degradation Data for Chemical Units in a Chemical Warfare (CW) Environment	29
7. Performance Degradation Data for Engineer Units in a Chemical Warfare (CW) Environment	38
8. Performance Degradation Data for Infantry Units in a Chemical Warfare (CW) Environment	42
9. Performance Degradation Data for Medical Units in a Chemical Warfare (CW) Environment	45
10. Performance Degradation Data for Military Police Units in a Chemical Warfare (CW) Environment	50
11. Performance Degradation Data for Ordnance Units in a Chemical Warfare (CW) Environment	51
12. Performance Degradation Data for Quartermaster Units in a Chemical Warfare (CW) Environment	54
13. Performance Degradation Data for Signal Units in a Chemical Warfare (CW) Environment	59
14. Performance Degradation Data for Transportation Units in a Chemical Warfare (CW) Environment	61
15. Cyclic Work/Rest Values (Minutes) with Negligible Heat Casualties	68
16. Work/Rest Times (Minutes)	69
17. Maximum Times (Minutes) with Minimum Heat Casualties. . .	72

THE EFFECT OF CHEMICAL PROTECTIVE CLOTHING AND EQUIPMENT ON COMBAT EFFICIENCY

1. INTRODUCTION

With the recent renewed interest in chemical warfare, there have been efforts to analyze the effects of this type warfare by means of models and/or computer simulations of battlefield scenarios. Part of these efforts have been addressed to the degradation of unit effectiveness as a result of having to wear and work in chemical protective gear.

The vulnerability of troops exposed to a toxic chemical agent environment can be reduced by donning protective clothing and equipment such as a mask, hood, gloves, overgarment, and boots. At the same time, however, wearing these items, particularly for extended periods of time and/or at high ambient temperatures ($>80^{\circ}\text{F}/27^{\circ}\text{C}$), frequently reduces the efficiency of individuals performing their assigned tasks. This individual degradation can and does eventually reduce the overall combat effectiveness of entire units.

A large portion of the degradation of individual and unit efficiency can be attributed to several inherent characteristics associated with the individual items that comprise the chemical warfare (CW) protective ensemble. Specifically, these include the following:

- Heat stress or heat build up due to the weight and bulkiness of the overgarment. The lack of "breathability" of the overgarment also contributes to the heat build up.
- Respiratory stress due to the air resistance of the protective mask filters and outlet valves.
- Reduced dexterity in the forearm portion of the overgarment and reduced manual dexterity due to wearing gloves. Some loss of dexterity can also be associated with the overboots.
- Restricted vision and hearing (communications) due to mask design.

In addition, morale and psychological stress, which are functions of being under attack, are contributing factors to the general physical discomfort caused by the protective clothing. Of these, only heat stress has been investigated in depth or quantified to any extent, primarily through the efforts of Dr. Goldman and his associates at USARIEM (US Army Research Institute of Environmental Medicine). Quantitative evaluations of other factors affecting degradation have been rather limited.

The amount of degradation in unit effectiveness from heat stress caused by wearing CW protective clothing is a function of several variables. Among these are (1) the type and combinations of environmental and protective ensemble worn, (2) the environmental conditions prevailing at any given time, (3) the duration during which a specific ensemble is worn, (4) the level of labor or activity sustained during the time a specific ensemble is worn, (5) the physical state of the personnel at the time the CW ensemble is donned, and (6) the degree to which the unit is trained in wearing protective clothing.

The Army employs the Mission-Oriented Protective Posture (MOPP) system to protect personnel against chemical agent attack. This is a flexible system intended to serve as a guide to commanders and is designed to facilitate mission accomplishment. It "requires the soldier to wear individual protective equipment consistent with the chemical threat, the workrate imposed by the mission, and the temperature".⁸ A tabulated summary of current MOPP levels is shown below.

TABLE 1 - DEFINITION OF MOPP LEVELS

PROTECTIVE CLOTHING AND EQUIPMENT				
MOPP	OVERGARMENT	OVERBOOTS	MASK/HOOD	GLOVES
1	Worn, open or closed based on temperature	Carried	Carried	Carried
2	Worn, open or closed based on temperature	Worn	Carried	Carried
3	Worn, open or closed based on temperature	Worn	Worn, hood open or closed based on temperature	Carried
4	Worn, closed	Worn	Worn, hood closed	Worn
Baseline	Not worn	Not worn	Not worn	Not worn

This report will be limited to MOPP 4, full or maximum protection, and the baseline condition, which is no protective clothing at all (only the normal duty uniform consistent with a specific task and environmental conditions). Also, no attempt will be made to determine what portion of the total amount of degradation can be attributed to any specific item of the CW ensemble.

2. APPROACH/RATIONALE

Earlier attempts to model degradation reportedly have been inadequate, one of the major reasons being a lack of empirical data with which to validate the models. The US Army Materiel Systems Analysis Activity (AMSAA) has initiated a program designed to provide these data. The objective of the first portion of this program is to establish and develop a data base which can be utilized to provide realistic information regarding the tactical effectiveness of units in a chemical warfare environment by means of computer simulations.

The successful establishment of a viable data base would enable the accuracy and validity of previous modeling efforts to be determined. It might also serve as the basis for the development of an entirely new model. The demonstration of a reliable model with which to ascertain the realistic effects of degradation would reduce the need for a costly and time-consuming test program. Current doctrine, training, and equipment, as they relate to CW, need to be evaluated now, so that any modifications that are required could be initiated and implemented without undue delay (as is likely to result from an extensive test program). Subsequent tests and training exercises could be employed to refine and validate existing data.

A two-phased approach was employed in developing the data base. One phase involved the review of the literature to determine if results or data from any earlier tests or studies were applicable to this program. Examples of the specific types of information sought included the following:

- Tasks or functions normally performed by military personnel, as individuals or as units, in tactical situations;
- Times to perform specific tasks (see note below);
- The degree of protection, or MOPP level, employed by personnel while performing specific functions;
- Temperature conditions prevailing at the time the specific functions were performed;
- Any previous modeling efforts that might provide information that could be applied to this program.

NOTE: At this point in the program, time was selected as the primary parameter to be considered in determining any decrease in unit effectiveness because of the ease by which it can be measured, and because differences in time are readily comprehensible. In addition, time is a critical factor to be considered in the activities of any unit within the area of tactical operations. However, it is recognized that there are other parameters that can be employed to measure unit effectiveness. These include the probability of hit, rate of fire, target acquisition, effective ranges, etc. It is anticipated that these also will be studied later in this program.

Concurrent with the literature review, a survey (Phase 2) was conducted to obtain and catalog the major functions or tasks that various units within the different branches of the Army might be required to perform in tactical situations. The branches surveyed include combat, combat support, and combat service support types. Specifically, these were air defense, armor, artillery, aviation, chemical, engineer, infantry, medical, military police, ordnance, quartermaster, signal, and transportation.

Items of particular interest in this survey included the size and type of the unit (including personnel and vehicles), the specific major functions that these units frequently perform, and workload (heavy, moderate, light) or amount of energy required to accomplish these tasks. Examples of functions in which heavy workloads are required include the loading/unloading of ammunition by hand, a forced march, digging with hand tools, infantry in dismounted attack, etc. Moderate workloads are exemplified by tasks such as infantry in dismounted defense, activity normally associated with units in reserve positions, some reconnaissance missions, certain maintenance operations, etc. Light workloads usually imply activities such as administrative tasks or motorized movement. In addition, the times required to perform these functions without chemical protective equipment were obtained. The times assumed relatively ideal conditions, e.g., daylight, moderate weather, trained troops, etc.

The majority of information (function, workload, times w/o CW gear) was obtained through interviews with officer personnel of rank O3 to O6 assigned to the various APG activities (AMSAA, TECOM, OC&S, MTD). The manner in which this was done was to (a) select officers from the different branches represented on the personnel rosters of the activities, (b) have discussions with as many from each branch as practical, then (c) prepare tables as shown in this report based upon these discussions. The information was essentially first hand in that these officers had commanded units that performed these specific tasks. The times were those they considered to be reasonable to accomplish the task (w/o protective gear), times they would accept as the commanding officer of the unit. The higher ranking officers displayed more experience in more diverse areas; the lower ranks had more recent, albeit limited, experience. In some instances, the officers interviewed had participated in the preparation of ARTEPs (Army Training and Evaluation Programs). Others had participated in training exercises in which CW protective gear had been worn. (Although they were not able to provide any quantitative data, they did provide some valuable opinions and estimates of the effects of CW protective gear.) Additional or supplementary information was obtained from the appropriate FMs (field manuals), TMs (training manuals), SQTs (skill qualification tests), and ARTEPs.

The tabulated data obtained in this manner to date are given in Tables 2-14 (first 5 columns). Briefly, this information includes the following:

- o The type and size of the unit of interest;
- o The major functions performed by the unit (along with a descriptive or qualifying phrase where applicable);

- o The level of workload required to perform the function;
- o The amount of time that could reasonably be expected to be taken to accomplish the function, without any protective clothing (wearing only the normal duty uniform in keeping with task requirements).

Times shown for performing tasks without protective clothing assume relatively ideal conditions of daylight, moderate weather, trained troops, etc. It was also assumed, again where no CW protective gear is worn, that there would be no difference between the time required to perform a specific task at temperatures near 20°F than it would at moderate temperatures (~60°F). The fact that wearing cold weather clothing in itself (w/o CW gear) may influence the performance of personnel not considered at this point in the program. As data become more refined, however, this may need to be addressed.

3. RESULTS AND DISCUSSION

After several documents were reviewed¹⁰⁻¹⁸, it became apparent that there was a paucity of quantified information concerning the degradation of unit effectiveness as a result of wearing CW protective equipment. Much of the data were of a subjective nature and therefore were considered to be of limited validity and applicability. Test conditions varied and were sometimes uncontrolled, thereby making comparisons difficult.

A detailed review of all the documents examined will not be presented here. However, it should be noted that two recent reports^{19,20}, published subsequent to the initiation of the work described herein, provide excellent summaries of previous chemical performance testing. The first of these¹⁹ presents the results of a literature search made to examine the effects of the use of chemical protective clothing and equipment on mission performance. From the list of reports reviewed, several were selected for further analysis. A critical assessment of these tests was made and the findings reported in Reference 20.

Some of the major points of this assessment²⁰ include the following:

- There was no uniformity in the structure of the tests, the parameters they attempted to measure, or in the manner in which performance was measured. This was attributed to the fact that the tests were performed over a period of 20 years, were conducted by different organizations, and were conducted under different technological and military conditions.
- The greatest amount of data is available for infantry missions and tasks, and cover attack, defense, and retrograde operations for squad, platoon, and company size units. A disadvantage is that most of the data are presented in terms of staytime, the length of time an individual remains in protective gear until he becomes a

casualty or until the unit becomes ineffective because of heat stress.

- The duration of most of the tests was too short to be able to assess the effects of rotation of individuals or tasks to maximize unit effectiveness over time.
- There are almost no data for a tank company or battalion.
- Artillery data are limited. There was no live firing, and the scope of tests was limited.
- There was little or no data for any specialized type of combat, such as airborne operations, river crossing operations by engineer units, etc.
- No data were available for cold weather conditions, or for operations over rough terrain or in deserts.
- No extensive testing was done over a variety of MOPP conditions.
- No tests were reported in which females were included.

A review of the literature, specifically those reports in which previous efforts to model degradation were described¹¹, 21-23, also indicated that each model had some limiting factors that generally restricted, or qualified its use. The principal deficiency most frequently mentioned was the lack of sufficient empirical data with which to verify the model or to determine its accuracy. As an attempt to provide this type of data, Tables 2-14 were developed.

Since the desired data were not available from traditional sources (results of field tests, training exercises, recorded but unpublished test results, etc.), it was necessary to calculate the time required to perform various functions while wearing full CW protection (MOPP 4). Calculations were made for three different temperatures, as indicated, and the results entered in the appropriate column.

The bases upon which these calculations were made are provided in Tables 15 and 16. Table 15 gives work/rest values extracted from FM 21-40.⁸ These data are intended to serve only as a guide to commanders to enable them to carry out their assigned missions with a minimum or negligible number of heat casualties. It should be noted that the indicated rest periods are those needed to allow an adequate amount of cooling time for the dissipation of accumulated body heat. Also, the work/rest values are cyclic and may be repeated for as many times as necessary to complete a task. The use of the data in Table 15 is somewhat limited, however, in that there are no data given for temperatures below 21°C (70°F). For a detailed discussion of the MOPP system, its use and implementation, the reader is referred to FM 21-40, Chapter 5.

* Revised MOPP tables are reportedly being prepared, but are not available at this time.

TABLE 2 - Performance Degradation Data for Air Defense Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
HIMAD Bn HQ (1) (Ops Con Cen)	Displacement, 12-15 trucks	Preparation for move (2)	Heavy	45 min	90 min	135 min	
	Emplacement at maximum cable length	Checkout and alignment	Heavy	30 min (2)	60 min	120 min	
	Displacement, 15-20 van/trucks, missile components only	Preparation for move	Heavy	60 min	120 min	360 min	
	Emplacement	Check out missile test equipment	Moderate	30 min (3)	30 min	90 min	
All others (5)	Displacement	Deliberate	Heavy	30 min	60 min	180 min	
	Emplacement		Moderate	30 min	30 min	90 min	
	Displacement (7)	Missile platoons	Heavy	30 min	60 min	180 min	
	Emplacement	Support platoon	Heavy	45 min	90 min	270 min	
SHORAD (6) Bn HQ	Displacement	Support platoon	Heavy	60 min	120 min	360 min	
	Emplacement	Missile platoons	Heavy	60 min (3)	120 min	360 min	
	Displacement, only 1 platoon	Support platoon	Heavy	30 min	60 min	180 min	
	Emplacement, only 1 platoon	HAWK	Heavy	30 min	60 min	180 min	
HIMAD Battery (8)	Displacement	HAWK	Heavy	45 min (3)	90 min	270 min	
	Emplacement	Platoon (10)	Heavy	15 min	30 min	90 min	
	Displacement	Support element	Heavy	30 min	60 min	180 min	
	Emplacement		Heavy	30 min	60 min	180 min	

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 2 - (continued)- Performance Degradation Data for Air Defense Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)		
					@20°F(-7°C)	@50°F(10°C)	@85°F(29°C)
SHORAD Battery (9)	Emplacement	Platoon	Heavy	20 min	40 min	60 min	120 min
MANPAD (11)	Displacement	Support element	Heavy	30 min	60 min	90 min	180 min
	Emplacement	By team (12)	Moderate	15 min	15 min	15 min	45 min
FAAR (13)	Emplacement	By team	Moderate	15 min	15 min	15 min	45 min
	Displacement		Heavy	15 min	30 min	45 min	90 min
	Emplacement		Heavy	15 min (14)	30 min	45 min	90 min

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

- (1) HAWK Bn. Includes computer/control (C/c) system W/generators, radars W/generators, and commo vans W/generators.
- (2) Moves for strategic purposes average 30 km; moves for survivability average 1-2 km.
- (3) Assumes that all equipment is operating. Problems requiring trouble shooting and/or repair would require additional time of 30 min to 2 hours.
- (4) Unit contains maintenance and repair parts; is attached to HIMAD En Hq.
- (5) Includes motor pool, supply room, mess facility, medical support, property book section, etc.
- (6) SHORAD Bns have either Chaparral or Vulcan systems.
- (7) Does not have C/c system, or a direct support platoon.
- (8) Includes 3 Fire Platoons W/all missile equipment and all support (motor pool, supply room, HQ, mess facility, tents, etc.).
- (9) SHORAD batteries deployed by platoons.
- (10) Platoon has 4 vehicles, either guns or SP missile launchers, self-contained.
- (11) Man Portable Air Defense (MANPAD). Employs REDEYE system, being replaced by STINGER system.
- (12) Team consists of 2 men with jeep and trailer.
- (13) Forward Area Alerting Radar (FAAR). Deployed individually, on a vehicle.
- (14) Assumes equipment is working. If not working, assistance must be requested. It could take up to an hour, or more, to obtain help.

NOTES: (a) HIMAD systems include the NIKE HERCULES. Multiply times by 2 or 3 for NIKE HERCULES system.

(b) All times given for HIMAD systems are for the HAWK system.

(c) SHORAD times apply to both CHAPARRAL and VULCAN systems.

TABLE 3 - Performance Degradation Data for Armor Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Battalion, HQ (Located ~ 8 km back of FEBA)	Displacement of Bn HQ	Hasty (ready to move) 1/	Heavy	15 min	30 min	45 min	90 min
		Deliberate (ready to move)	Heavy	30 min	60 min	90 min	180 min
	Emplacement of BN CP	Hasty, for radio communication only	Heavy	15 min	30 min	45 min	90 min
		Deliberate, completely operational	Heavy	2 hrs	4 hrs	6 hrs	12 hrs
Brigade Trains, located ~ 20 km back of FEBA	Lay Wire (wire section, 5 men)	Minimum amount of wire required	Heavy	1 hr	2 hrs	3 hrs	6 hrs
	Antenna emplacement, 3-4 men (H577A1 crew)	RC-292 antenna	Heavy	20 min	40 min	60 min	120 min
	Maintenance	Get ready to move	Heavy	2 hrs	4 hrs	6 hrs	12 hrs
		Get operational once reach new site	Heavy	2 hrs	4 hrs	6 hrs	12 hrs
		To be fully operational at new site	Heavy	4 hrs	8 hrs	12 hrs	24 hrs
	Battalion Aid Station (BAS)	To get ready to move	Heavy	1 hr	2 hrs	3 hrs	6 hrs
Company, 3 Platoons, 15 Tanks	Maintenance	To set up in new position	Heavy	1 hr	2 hrs	3 hrs	6 hrs
		Organizational, per move	Moderate	1 hr	1 hr	1 hr	3 hrs
		Organizational, per road march	Moderate	1 hr	1 hr	1 hr	3 hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 3 - (continued) - Performance Degradation Data for Armor Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)
COMPANY, 3 Platoons, 15 Tanks Platoon, 5 Tanks	Position Selection	By commander, per move	Moderate	1 hr	020°F (-7°C)	050°F (10°C)	085°F (29°C)
	Command post move	Per move	Moderate	15 min	15 min	15 min	45 min
	Displacement, ~ 5km distance	Hasty (ready to move)	Moderate	< 1 min	< 1 min	< 1 min	~ 5 min
		Across desert @ ~ 20km/hr	Light	15 min	15 min	15 min	15 min
		Across rough terrain (rocks, gullies) @ ~ 10-15 km/hr	Light	20 min	20 min	20 min	20 min
		Across terrain where no trail exists @ ~ 2-3 km/hr	Light	2 hrs	2 hrs	2 hrs	3.5 hrs
		Advancing with infantry @ 2-3 km/hr	Light	2 hrs	2 hrs	2 hrs	3.5 hrs
	Maintenance	Replace tank engine (4 men, pull and reinstall)	Heavy				
		For XM1		2 hrs	4 hrs	6 hrs	12 hrs
		For M60		4 hrs	8 hrs	12 hrs	24 hrs
		Replace track (done in place by crew)	Heavy				
		For thrown track		1 hr	2 hrs	3 hrs	6 hrs
Platoon		For damaged track		2 hrs	4 hrs	6 hrs	12 hrs
		Clean air filters. ^{2/} For XM1	Heavy	1 hr	2 hrs	3 hrs	6 hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 3 - (continued) - Performance Degradation Data for Armor Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Platoon	Maintenance (cont)	Daily, routine	Light/ Moderate	1 hr/move	1 hr/move	1 hr/move	1.5 hr/move
		After road march	Light/ Moderate	1 hr	1 hr	1 hr	1.5 hr
	Recovery ^{3/}	Time for notification to travel to site	Light	30 min	30 min	30 min	30 min
		Time to hook up	Moderate	15 min	15 min	15 min	45 min
Platoon, Transportation	Ammunition resupply	Full turn around ^{4/}	Light/Heavy	4 hrs	6 hrs	8 hrs	12 hrs
		From Brigade trains to tanks	Light/Heavy	2 hrs	3 hrs	4 hrs	6 hrs
	Refuel	For 5 tanks: M60 (250 gallon) XM1 (375 gallon)	Moderate Moderate	1.5 hrs 2.5 hrs	1.5 hrs 2.5 hrs	1.5 hrs 2.5 hrs	2.5 hrs 4.5 hrs
	Refill fuel tankers ^{5/}	Turn around time (top off in trains area)	Moderate	2 hrs	2 hrs	2 hrs	3 hrs
Troop, Ground CAV (Company Size) ^{6/}	Resupply tank ammunition, for M60	Load 30 cannon rds	Heavy	30 min	60 min	90 min	180 min
		Load .50-cal, 7.62mm, smoke grenades, as required	Heavy	15 min	30 min	45 min	90 min
	Fire mission, 4.2-inch mortar	Preplanned (preset)	Heavy	10rds/min	8rds/min	6rds/min	4rds/min
		Not preplanned, usually sustained	Heavy	6rds/min	5rds/min	4rds/min	2rds/min

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 3 - (continued) - Performance Degradation Data for Armor Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
					@20°F (-7°C)	@85°F (29°C)
Troop Ground CAV (Company Size)	Preparation for fire mission	Unpack and set charges (PD fuzes)	Heavy	1.5 min/rd	2 mins/rd	4 mins/rd
	Site occupation	Hasty	Heavy	15 min	20 min	90 min
		Deliberate	Heavy	20 min	40 min	120 min
	Site displacement	Hasty	Heavy	5 min	10 min	10 min
		Deliberate	Heavy	30 min	60 min	180 min
	Recon area 5km x 5km	To refuel M113	Moderate	20 min	20 min	35 min
Platoon, Scout (Recon) (9 M113's)		To rearm M113 (machine gun)	Heavy	15 min	30 min	90 min
		To displace (in dis-mounted mode)	Moderate	5 min(max)	5 min	10 min

1/ All moves, unless otherwise stated, are made at 30km/hr.

2/ Filters removed, shaken, and replaced. Done after approximately every 10 hours of operation.

3/ Rate of travel during recovery: tank w/o track, 8 km/hr; tank w/track, 20 km/hr.

4/ Loaded truck going from Brigade Trains area to tanks, back to ASP, reload, back to Brigade trains.

5/ Tankers going from Brigade Trains area to tanks, back to POL supply, reload, back to Brigade Trains.

6/ Primary function is reconnaissance, but strong enough to fight.

7/ Perform route recon, early warning, flank security, rear area security. Range from 2 km forward of FEBA to 5-10KM back of FEBA.

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 4 - Performance Degradation Data for Artillery Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOFP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOFP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOFP 4 (FULL PROTECTIVE ENSEMBLE)
Battalion (BQS)	Site Occupation	Emergency ^{2/} (For FDC only)	Heavy	~ 20 min	40 min	60 min	120 min
		Deliberate ^{3/}	Heavy	~ 20 min	40 min	60 min	120 min
	Site Displacement	Emergency ^{4/} (For FDC only)	Heavy	6 min	12 min	12 min	36 min
		Deliberate ^{5/}	Heavy	30 min	60 min	90 min	180 min
	Fire Mission ^{7/}	6 Howitzers/5 volleys (1 in Effect)	Heavy	8.5 min	17 min	25.5 min	51 min
155 (SP) Battery	Site Occupation	Emergency ^{2/}	Heavy	15 min	30 min	45 min	90 min
		Deliberate ^{3/}	Heavy	20 min	40 min	60 min	120 min
	Site Displacement	Emergency ^{4/}	Heavy	3 min	6 min	9 min	18 min
		Deliberate ^{5/}	Heavy	30 min	60 min	90 min	180 min
	Road March	30 km/hr	Light	(Max) 12 hrs day	12 hrs day	12 hrs day	12 hrs day
	Reconnaissance and Position Selection	Deliberate	Moderate	~ 1 hr	1 hr	1 hr	1.5 hr
	Maintenance	Organization	Variable	N/A	N/A	N/A	N/A
	Ammo Supply	Turn around time for 10km trip 6/-5 ton truck/155mm ammo	Moderate - Heavy	4 hrs	4-6 hrs	4-8 hrs	6-12 hrs
	Site Occupation	Emergency ^{2/}	Heavy	2 min	4 min	6 min	12 min
	Site Displacement	Deliberate ^{3/}	Heavy	5 min	10 min	15 min	30 min
Howitzer Section		Emergency ^{4/}	Heavy	3 min	6 min	9 min	18 min
		Deliberate ^{5/}	Heavy	30 min	60 min	90 min	180 min

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).
NOTE: Footnotes on following page.

TABLE 4 (continued) - Performance Degradation Data for Artillery Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
					82°F (-7°C)	85°F (29°C)
Fire Direction Section	Fire Mission	1 round/min (6 rds)	Moderate	6 min	6 min	9 min
	Service Ammo	1 round/min (6 rds)	Heavy	6 min	12 min	36 min
	Site Occupation	Emergency	Heavy	20 min	40 min	120 min
	Site Displacement	Deliberate	Heavy	20 min	40 min	120 min
	Compute Fire Mission	Emergency	Heavy	3 min	6 min	18 min
Forward Support Team (FIST)	Target Identification	Will vary by type	Light	Variable	Variable	Variable
		Time from identification and call for fire.	Light	1 min	1 min	1 min

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

- 1/ Bn HQ's are usually but not always within 3-5 km of all batteries.
- 2/ EMERGENCY SITE OCCUPATION is a physical move of about 500 meters performed under emergency conditions. Times given refer to the time elapsed between the moment the lead vehicle has entered the new site until the unit is able to commence operations.
- 3/ DELIBERATE SITE OCCUPATION is a physical move of about 7km performed under tactical conditions. Times given refer to the time elapsed between the moment the lead vehicle has entered the new site until the unit is able to commence operations.
- 4/ EMERGENCY SITE DISPLACEMENT is a physical move of about 500 meters performed under emergency conditions. Times given refer to the time elapsed between the moment the order to move is given until the first vehicle has entered the new site and include movement time.
- 5/ DELIBERATE SITE DISPLACEMENT is a physical move of about 7km performed under tactical conditions. Times given refer to the time elapsed between the moment the order to move is given until the first vehicle has entered the new site and include movement time.
- 6/ From division ASP to firing battery and return. Includes loading of ammunition.
- 7/ Time for the fire mission refers to the time elapsed between the moment the battery receives the FM until the rounds have been fired. Does not include time of flight.

Table 5 - Performance Degradation Data for Aviation Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
				020°F (-7°C)	050°F (10°C)	085°F (29°C)
Combat Aviation Battalion ^{1/}	Site Location and Relocation ^{2/}	Breakdown to move ~ 25km (from time order given to move till first vehicle moves)	Heavy	3 hrs	6 hrs	18 hrs
		Set-up upon reaching new position (time from arrival of first vehicle until operational)	Heavy	2 hrs	4 hrs	12 hrs
	Road March	30km/hr	Heavy	12 hrs max	12 hrs max	12 hrs max
	Maintenance, Scheduled	Daily (if aircraft flew day before)	Moderate	1 hr/air - craft(ac)	1 hr/ac	3 hrs/ac
		Every 25 hrs of flying time ^{3/}	Moderate	~ 3 hrs/ac	~ 3 hrs/ac	~ 9 hrs/ac
		Every 100 hrs of flying time ^{3/}	Moderate	~ 72 hrs (avg)/ac ^{4/}	~ 72 hrs/ac	~ 216 hrs/ac
		For UH-60, daily	Moderate	2 hrs/ac	2 hrs/ac	6 hrs/ac
		For UH-60, after 50 hrs flying time	Moderate	6 hrs/ac	6 hrs/ac	18 hrs/ac
		For UH-60, after 300 hrs flying time	Moderate	144 hrs/ac	144 hrs/ac	432 hrs/ac
	Maintenance, Unscheduled	Depending upon number of days elapsed & hrs flown in combat	Moderate	Daily hrs + scheduled hrs x2	Daily hrs + scheduled hrs x2	Daily hrs + scheduled hrs x3

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

Table 5 (continued) - Performance Degradation Data for Aviation Units in a Chemical Warfare (Ch.) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)
	Spare Parts Acquisition	From an Aviation Maintenance Support Company located about 10 km away; via motor vehicle (~20 km roundtrip)	Light	3 hrs	3 hrs	3 hrs	5.25 hrs
		From Corps Support Command (COSCOM) located about 50 km away; via aircraft (~100 km roundtrip). ^{5/}	light	1.5 hrs	1.5 hrs	1.5 hrs	2.0 hrs
	Refue:	Hot. ^{5/}	Moderate	10 min	10 min	10 min	20 min
	Rearm. ^{7/}	Cold	Heavy	30 min	60 min	90 min	180 min
	Briefing	For combat assault	Light	1 hr	1 hr	1 hr	1.25 hr
		For parts run	Light	10 min	10 min	10 min	12 min
	Debriefing	For recon mission	Light	1 hr	1 hr	1 hr	1.25 hr
		For parts run	Light	0	0	0	0
	Mission planning	For combat assault, 3 people	Light	4-5 hrs	4-5 hrs	4-5 hrs	6 hrs
	Reconnaissance. ^{8/}	Visual: 25km to area (from Bn); area 20 x 20 km	Moderate	Area 20 km x 20 km	Area 10 km x 10 km (day)	Area 10 km x 10 km (day)	Area 10 km x 10 km (day)
	Target Acquisition. ^{9/}	Scout-provides Azimuth and range	Moderate	20 sec	25 sec	25 sec	25 sec

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

Table 5 (continued) - Performance Degradation Data for Aviation Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					@20°F (-7°C)	@50°F (10°C)	@85°F (29°C)
	Target Acquisition	Gunship - "pop-up," and fire Weapons: HELLFIRE (fire & forget) 5000-6000m TOW @ 3750m 40mm @ 1000m 2.75-in rocket - fire & forget 20mm @ 2000m Turn around	Moderate 0 15 sec 5 sec 0	10 sec 0 20 sec 10 sec 0	15 sec 0 20 sec 10 sec 0	15 sec 0 20 sec 10 sec 0	15 sec 0 20 sec 10 sec 0
	Missions: Resupply		Medium	Variable	Not inhibited by CW	Not inhibited by CW	Not inhibited by CW
	Command and Control		Medium	Variable	Not inhibited by CW	Not inhibited by CW	Not inhibited by CW
	Medical Evacuation		Medium	Variable	Not inhibited by CW	Not inhibited by CW	Not inhibited by CW
	Airlift		Medium	Variable	1.2 x expected time	1.2 x expected time	1.2 x expected time

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

- 1/ Unit operates with OH-58, UH-1, and AH-1S aircraft. Unit will also have UH-60 and EH-1H aircraft which are treated separately with respect to maintenance.
- 2/ Multiply times by 1.5 for night operations.
- 3/ For UH-1, OH-58, and AH-1S.
- 4/ Total down time of 72 hours with more than one mechanic working.
- 5/ Generally an emergency request with prior notification.
- 6/ Engine running.
- 7/ 40mm - 30min; 2.75-In - 15 min; TOWs (8 ea) - 30 min on AH-1S; 20mm - 15 min
- 8/ Recon done by 2 each OH-58 with 2.5 hours of fuel, 2 hours of which is mission time including to and from the area as well as the recon maneuvers over the designated area. Recon conditions assumed: nap of the earth to recon area, at appropriate altitude over the area, at an air speed permitted by the terrain, return with 30 minutes of fuel remaining.
- 9/ Scout (OH-58) / Gunship (AH-1S) team operating together. Scout acquires target, directs gunship; in azimuth and range.

TABLE 6 - PERFORMANCE DEGRADATION DATA FOR CHEMICAL UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)
HBC Defense Company	Respond to Receipt of Warning Order	Planning	Light		020°F (-7°C)	050°F (10°C)
	Prepare the Operating Area for Occupancy	Prepare	Moderate			
	Move the Company to the Operating Area	Movement	Moderate	NOTE: At the time of publication no data had been received.		
	Establish Unit Defense	Prepare	Moderate			
HBC Defense Company, Platoon	Prepare for Movement	Preparation	Moderate			
	Platoon Moves to Bde HQ	Movement	Moderate			
	Position Equipment and Materiel	Prepare	Heavy			
	Camouflage Equipment	Prepare	Heavy			
	Maintain Equipment	Reconstitution	Moderate			
	Request Operating Supplies	Reconstitution	Light			
	Prepare for Operations	Preparation	Moderate			
	Coordinate/Liaison with Control HQ	Planning	Light			
	Establish and Maintain Radio Commo	Prepare	Moderate			

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 6 (continued) - PERFORMANCE DEGRADATION DATA FOR CHEMICAL UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
NBC Defense Company, Platoon (continued)	Establish and Maintain Wire Commo	Prepare	Moderate	020° F (-7° C)	050° F (10° C)	085° F (29° C)
	Site Platoon HQ.	Prepare	Heavy			
	Control Deployed Squads	Recon/Decon	Light			
	Coordinate Resupply for Recon	Prepare	Light			
	Coordinate Resupply for Decon	Prepare	Light			
NBC Defense Company, Recon Squad	Plan and Prepare a Nuclear Reconnaissance	Planning	Light			
	Conduct a Nuclear Reconnaissance	Recon	Heavy			
	Return from Mission	Reconstitution	Moderate			
	Plan and Prepare for Aerial Survey	Planning	Light			
	Conduct Aerial Survey	Recon	Heavy			
	Establish AGCF	Calculate Dose Rate	Heavy			
	Return to Control HQ	Reconstitution	Moderate			

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 6 (continued) - PERFORMANCE DEGRADATION DATA FOR CHEMICAL UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE) 020°F (-7°C)	085°F (29°C)
M2C Defense Company, Recon Squad (continued)	Plan and Prepare a Chemical Reconnaissance	Planning	Light			
	Conduct a Chemical Reconnaissance	Recon	Heavy			
	Return from Mission	Reconstitution	Moderate			
	Plan and Prepare for Biological Sampling	Planning	Light			
	Conduct Biological Sampling	Recon	Heavy			
	Return from Mission	Reconstitution	Light			
	Plan and Prepare for Recon to Locate Appropriate Recon Site	Planning	Light			
	Conduct Recon for Decon	Recon	Heavy			
	Return from Mission	Reconstitution	Moderate			
	Plan and Prepare for a Recon	Planning	Light			
	Conduct a Recon	Recon	Heavy			
	Locate the Composing Force	Recon	Heavy			
	Treat and Evacuate Casualties	Medical Aid	Heavy			
	Return to Assembly Area	Reconstitution	Moderate			

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 5 (continued)- PERFORMANCE DEGRADATION DATA FOR CHEMICAL UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
US Defense Company, Recon Squad, Tech	Preparation of Equipment for mission	Prepare individual and patrol equipment and vehicles.	Moderate		020°F (-7°C)	085°F (29°C)
	Reconnoiter danger areas dismounted	Danger areas such as bridges, defile, curve in road, road inter-sections.	Very Heavy			
	Use radio communication	Send and receive messages	Light		(1)	(1)
	Survey and mark PDS/EDS Site	Mark areas for establishing stations on a PDS/EDS site.				
	Use the M34 soil sampling kit	Use the M34 kit to collect 810 samples, water samples and soil samples.	Moderate			
	Use the ABC-M2 water testing kit	Use to collect water sample and check for contamination.	Moderate			
	Use the IM-174 radiological meter	Take readings from stationary position and while traveling or surveying.	Moderate			
	Decontaminate unit equipment	Perform complete decontamination of a level I Mech Inf Bn.	Heavy	(2)	37 hrs	

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 6 (continued)—PERFORMANCE DEGRADATION DATA FOR CHEMICAL UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE) 020°F (-2°C)	085°F (10°C)
NBC Defense Company, Recon Squad, Team (continued)	Service the automatic chemical agent alarm.	Perform required services after extended operation.	Moderate	30 min		085°F (10°C)
	Test for chemical agents using a detector kit.	Perform required tests to determine chemical agent presence.	Moderate	15 min		
	Test water for chemical contamination.		Moderate	30 min		
	Collect biological samples.	Perform required actions to collect biological samples.	Moderate	15 min		
	Monitor personnel supplies and equipment for radiation hazards.		Light	Dependent		
	Conduct NBC reconnaissance.					
	Smoke Operations		Heavy	Dependent		
	Conduct radiological surveys.		Moderate	Dependent		
	Perform site reconnaissance for decontamination site.			Dependent		

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 6 (continued)—PERFORMANCE DEGRADATION DATA FOR CHEMICAL UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)
NBC Defense Company, Decon Squad	Plan and Prepare for PDS Establishment	Planning	Light			020°F (-7°C)
	Establish PDS	Prepare	Heavy			050°F (10°C)
	Conduct Personnel Decon	Decon	Heavy	(2)		085°F (29°C)
	Prepare and Submit Operational Status Reports	Reporting	Light			
	Close PDS and Prepare for Movement	Reconstitution	Heavy	(2)		
	Plan and Prepare for Complete Equipment Decon	Planning	Light			
	Decon Equipment	Decon	Heavy	(2)		
	Close EDS and Prepare for Movement	Reconstitution	Heavy	(2)		
	Plan and Prepare for Terrain Decon	Planning	Light			
	Decon the Terrain	Decon	Heavy	(2)		
	Complete the Operation and Prepare for Movement	Reconstitution	Heavy	(2)		

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 6 (continued)—PERFORMANCE DEGRADATION DATA FOR CHEMICAL UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/G PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
					020°F (-7°C)	050°F (10°C)
NBC Defense Company, Decon Squad (continued)	Plan and Prepare for PDS/EDS Establishment	Planning	Light			085°F (29°C)
	Establish PDS/EDS	Prepare	Heavy	(2)		
	Conduct Personnel Decon	Decon	Heavy	(2)		
	Decon Equipment	Decon	Heavy	(2)		
	Close PDS/EDS and Prepare for Movement	Reconstitution	Heavy	(2)		
	Plan and Prepare for a Hasty Decon	Planning	Light			
	Establish a Hasty Decon Point	Prepare	Heavy	(2)		
	Decon Equipment	Decon	Heavy	(2)		
	Close Point and Prepare for Movement	Reconstitution	Heavy	(2)		

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 6 (continued) - PERFORMANCE DEGRADATION DATA FOR CHEMICAL UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)
NBC defense Company, Decon Squad (continued)	Perform complete decontamination of personnel	Process personnel through a PDS (for a Mech. Inf. Co. of 175 personnel)	Moderate	(2)	020°F (-7°C) 30 min/2 per	050°F (10°C) 30 min/2 per	085°F (29°C) 30 min/2 per (3)
	Perform complete decontamination of equipment	Decon 16 APCs (M113A1s) of a Mech. Inf. Co.	Heavy	(2)	2hrs/vehicle	2hrs/vehicle	2hrs/vehicle (4)
	Prepare upper air wind data and detailed fallout predictions	Effective downwind msg fallout prediction	Light Light	45 min 20 min (5) (6)			
NBCE/JA/JB							

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

- (1) Messages must usually be repeated.
- (2) Decontamination operations are not performed w/o protective clothing.
- (3) Same time but station operators must be changed every 15 minutes.
- (4) Same time but station operators must be changed after each vehicle.
- (5) Standard is about 25 minutes.
- (6) Standard is about 15 minutes.

TABLE 7. PERFORMANCE DEGRADATION DATA FOR COMBAT ENGINEER UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
				020°F (-7°C)	050°F (10°C)	085°F (29°C)
Battalion HQ, S-2 Line Company 5/	Reconnaissance	Route recon, 2 men, avg. 10 km $\frac{1}{2}$	Moderate	2 hrs	2 hrs	6 hrs
	Mess facility (fold-up field kitchen)	Disassemble Assemble (to get operational)	Heavy Heavy	20 min $\frac{2}{3}$ 35 min	40 min 70 min	120 min 210 min
	Displacement, $\frac{3}{3}$ M577A1s	To new position (10-15km distance)	Light-Moderate	45 min/ea vehicle	45 min/ea vehicle	75 min/ea vehicle
	Load mines (manual)	Average minefield, 2 5-ton dumptrucks	Heavy	1.5 hrs	3 hrs	9.0 hrs
	Load demolitions (manual)	For road crater, 2 5-ton dumptrucks	Heavy	30 min	60 min	180 min
	Secure site	Organize work area	Light	15 min	15 min	25 min
	Reconnaissance	For obstacle locations, time from start till ready to order materials	Light/Moderate	45 min	45 min	105 min
		For class 50 or more bridge (to handle tank traffic)	Light/Moderate	3 hrs	3 hrs	~7 hrs
		For assault bridge (to cross river or ditch)	Light/Moderate	2 hrs	2 hrs	6 hrs
	Prepare hull defilade position, per tank per-digging vehicle $\frac{6}{6}$	For large gully w/o water Dirt berm around tank	Light/Moderate Moderate	30 min 30 min	30 min 30 min	90 min 90 min

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 7 - (Continued) - PERFORMANCE DEGRADATION DATA FOR COMBAT ENGINEER UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Line Company	Dig tank ditch, 2 digging vehicles in any combination	3.2m Wide x 1.8m deep	Moderate	2.5 hrs/100m length	2.5 hrs/100m length	2.5 hrs/100m length	
	Minefield emplacement: w/M57 towed mine dispenser	300m long x 50m deep <u>1/</u>	Moderate	1 platoon hr	1 platoon hr	3 platoon hours	
	By hand	100m long x 100m deep <u>1/</u>	Heavy	4 squad hrs	8 squad hrs	12 squad hrs	
	Disable bridges	4 lane highway	Heavy	3 squad hrs	6 squad hrs	9 squad hrs	
		2 lane primary road	Heavy	2 squad hrs	4 squad hrs	6 squad hrs	
	Build abatis (30 trees, 25-35 cm in diam.)	40 meters deep w/trees 2 meters apart	Heavy	2 squad hrs	4 squad hrs	6 squad hrs	
	Build road crater, average size (terrain dependent)	50m long x 25m wide x 4m deep	Heavy	2 squad hrs	4 squad hrs	6 squad hrs	
	Breach minefield	Hasty(w/bangalore torpedo-footpath wide)	Heavy	2 squad hrs	4 squad hrs	6 squad hrs	
		Using detector/probe 8-ft wide	Heavy	1 platoon hr	2 platoon hrs	3 platoon hrs	
		W/M157 demolition snake, 90m deep, 4-6m wide	Heavy	2 squad hrs	4 squad hrs	6 squad hrs	
	Bridging	Temporary fording <u>8/</u>	Heavy	1 hr for equipment	2 hrs for equipment	3 hrs for equipment	
		Mobile assault bridge: Ideal conditions w/fast current	Heavy Heavy	200m/hr 150m/hr	200m/2 hrs 150m/2 hrs	200m/3 hrs 150m/3 hrs	
						6 hrs for equipment	
						200m/6 hrs 150m/6 hrs	

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 7 - (Continued) - PERFORMANCE DEGRADATION DATA FOR COMBAT ENGINEER UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
					@20°F (-7°C)	@50°F (10°C)
Line Company	Bridging	Ribbon bridge ^{9/}	Heavy	5 min/bay	10 min/bay	15 min/bay
		Ribbon bridge, 100 foot length under ideal conditions ^{10/}	Heavy	3 hrs	5 hrs	9 hrs
		Bailey bridge, 25 m long, ideal conditions	Heavy	5.5 hrs (7 hrs in dark)	11 hrs	16.5 hrs

1/ Includes time from start, coordination with requesting unit, doing actual survey, completion of paper work, and return.

2/ Does not include travel time.

3/ Have 3 M577A1s; one always operational, 2 moving.

4/ Operates forward stockage point.

5/ Consists of 3 platoons of 3 squads each. Squads use one M113 (APC) + a 1.5-ton trailer; 8 men.

6/ Requested by armor unit. Performed ahead of time. Dig hole large enough to hide tank.

7/ Density of 0.5 mines/meter of front. Double times if density of 1 mine/meter of front is used.

8/ Knock down banks, grade, add gravel, etc.

9/ Medium girder bridge. Number of bays depends upon width of river. For each 3 bays, add 5 min for bridge erection boat.

10/ 42 people. assume trained troops. Add 50-100% if dark; add 30-50% for bad weather. Add 20% to time if untrained troops.

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 7(a). PERFORMANCE DEGRADATION DATA FOR COMBAT ENGINEER UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Note: Times are given in FM 5-34.	Mine emplacement, per man	Anti-tank Anti-personnel, frag Anti-personnel, blast	Heavy Heavy Heavy	4 mines/hr 8 mines/hr 16 mines/hr	4 mines/2 hrs 8 mines/2 hrs 16 mines/2 hrs	4 mines/3 hrs 8 mines/3 hrs 16 mines/3 hrs	4 mines/6 hrs 8 mines/6 hrs 16 mines/6 hrs
	Shelter, no revetment materials used	Open 1-man foxhole Open 2-man foxhole Open automatic rifle emplacement Open horseshoe type M50 MG emplacement 105-mm howitzer emplacement 155-mm howitzer emplacement	Heavy Heavy Heavy Heavy Heavy Heavy Heavy	2 hrs 3 man hrs. 4 man hrs 4 man hrs 100 man hrs 170 man hrs	4 hrs 6 man hrs 8 man hrs 8 man hrs 200 man hrs 340 man hrs	6 hrs 9 man hrs 12 man hrs 12 man hrs 300 man hrs 510 man hrs	12 hrs 18 man hrs 24 man hrs 24 man hrs 600 man hrs 1020 man hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 8 - Performance Degradation Data for Infantry Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
					@20°F (-7°C)	@50°F (10°C)
Squad, 9 man	Maintenance	Clean weapon	Light	15 min	20 min	20 min
	Position preparation, 2-man	Hasty, minimum protection,				
		In sand	Heavy	10 min	20 min	60 min
		In clay	Heavy	120 min	240 min	720 min
		In plowed, loose dirt	Heavy	30 min	60 min	180 min
		Deliberate, improved protection,				
		In sand	Heavy	20 min	40 min	120 min
		In clay	Heavy	240 min	480 min	1440 min
		In plowed, loose dirt	Heavy	60 min	120 min	360 min
		4 km @ 4 km/hr	Heavy	60 min	120 min	360 min
Maintenance Bn	Road march (normal)	Fast walk, 6 km/hr	Heavy	20 min	40 min	120 min
	Assault, 500 meters against moderate opposition					
	Rest, relief, mess	Protected	Light	Variable	Variable	Variable
	Refuel four M113's, turn around times, or Bn fuel tankers (1)(2)	15 km, refuel 4 vehicles, 15 km return, refill tanker	Light - Moderate	3.5 hrs	3.5 hrs	10.5 hrs
	Ammunition resupply, turn around time for Bn trucks (2)(3)	15 km, unload, 15 km return, reload truck	Light - Heavy	1.5 hrs	3.0 hrs	9.0 hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 8 (continued) - Performance Degradation for Infantry Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)	
					020°F (-7°C)	050°F (10°C)
Bn HQ (Combat)	Site displacement (4)	Hasty, 500 meters	Moderate	5 min	5 min	15 min
	Site emplacement	Hasty, erect antenna	Heavy	10 min	20 min	60 min
	Displacement	Move of 10 km or more, time from notification to march order	Heavy	35 min (6)	70 min	210 min
	DS Maintenance (5)	Emplacement, time to become operational upon arrival at new site.	Deliberate, POL	Light	Immediate	Immediate
Ammo			Light	Immediate	Immediate	Immediate
Mess			Heavy	45 min	90 min	270 min
Maintenance			Heavy	2 hrs	4 hrs	12 hrs
(1) Bn Maintenance Co assumed to be 15 km back of FEBA.						
(2) Bn resupply vehicles will travel as far as reserve company area and refuel vehicles or transfer ammunition to company vehicles.						
(3) Ammunition arrives at the Bn crated and palletized. Bn breaks down the ammunition for specific company requests. Transfers of all ammunition below Bn are manual.						
(4) Bn commander operates out of an M113 (stretch). Major task for this unit is the erection and dismantling of an M292 antenna. Generally located about 2 km back of company positions.						
(5) Generally 20 km back of the FEBA.						
(6) Road march time is not included.						

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 8a - Performance Degradation Data for Infantry Units in a Chemical Warfare (CW) Environment.**

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
					020°F (-7°C)	085°F (29°C)
TOW Crew	Firing Operation	(1) Mount TOW on M113A1 (TOW) for extended travel		(See Note 1)		(See Note 2)
		(2) Engage target from extended travel		2:16		5:00
		(3) Cease fire/out of action and move out in extended travel		0:50		1:23
		(4) Dismount TOW from extended travel		0:59		1:16
		(5) Engage target		0:60		1:56
		(6) Cease fire/out of action		0:19		0:44
		TOTAL ELAPSED TIME IN MINUTES		0:16 5:50		0:16 10:35
	Note 1: Condition is ready MOPP 1 = Soldiers carry protective mask; other MOPP gear is readily accessible.					
	Note 2: Temp. of test was 75°F					
	**Information supplied in letter ATSH-CO-MS-C, dtd 20 Feb 81.					

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 9 - PERFORMANCE DEGRADATION DATA FOR MEDICAL UNITS IN A CHEMICAL WARFARE (CW) ENVIRONMENT.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
					@20°F (-7°C)	@50°F (10°C) @85°F (29°C)
Medical Company	Establish clearing Station (able to receive patients)	To be minimally operational: ¹ In open area ² In wooded area ³	Moderate to heavy	2.5 hrs ⁴ 3.5 hrs	2.5 - 5 hrs ⁵ 3.5 - 7 hrs	2.5 - 7.5 hrs 7.5 - 15 hrs ⁶ 3.5 - 10.5 hrs 10.5 - 21 hrs
		For entire clearing station to be operational: In open area In wooded area	Moderate to Heavy	5.5 hrs 6.5 hrs	5.5 - 11 hrs 6.5 - 13 hrs	5.5 - 16.5 hrs 16.5 - 33 hrs ⁶ 6.5 - 19.5 hrs 19.5 - 39 hrs
		Minimally operational ⁸ In open area In wooded area	Moderate to Heavy	2 hrs 2.5 hrs	2 - 4 hrs 2.5 - 5 hrs	2 - 6 hrs 6 - 12 hrs ⁶ 2.5 - 7.5 hrs 7.5 - 15 hrs ⁶
	Disestablish clearing Station (receiving patients).	Complete In open area In wooded area	Moderate to Heavy	4 hrs 4.5 hrs	4 - 8 hrs 4.5 - 9 hrs	4 - 12 hrs 12 - 24 hrs ⁶ 4.5 - 13.5 hrs 13.5 - 27 hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc., unless otherwise noted.

Table 9 (continued) - Performance Degradation Data for Medical Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					820°F (-7°C)	850°F (10°C)	865°F (29°C)
Medical Platoon/ Section of Combat/Combat Support Unit	Establish Battalion's Aid Station (BAS): For Level 1 Unit ¹⁰	In M51 Shelter ¹¹	Moderate	20 min ¹²	30 min	30 min	1.5 hrs
		Under tentage ¹³	Moderate	20 min	20 min	20 min	1 hr
		Under tarp/shelter/lean-to	Light	10 min	10 min	10 min	18 min
		In an organic vehicle	Light	5 min	5 min	5 min	9 min
		In M51 Shelter	Moderate	60 min	60 min	60 min	3 hrs
		Under tentage	Moderate	30 min	30 min	30 min	1.5 hrs
	Disestablish BAS: ¹⁵ For Level 1 Unit	Under tarp/shelter/lean-to	Light	15 min	15 min	15 min	25 min
		In an organic vehicle	Light	10 min	10 min	10 min	18 min
		From M51 Shelter	Moderate	30 min	30 min	30 min	1.5 hrs
		From under tentage	Moderate	20 min	20 min	20 min	1 hr
		From under tarp/shelter/lean-to	Light	10 min	10 min	10 min	18 min
		From an organic vehicle	Light	5 min	5 min	5 min	9 min
	For Level 2 Unit	From M51 Shelter	Moderate	60 min	60 min	60 min	3 hrs
		From under tentage	Moderate	30 min	30 min	30 min	1.5 hrs
		From under tarp/shelter/lean-to	Light	15 min	15 min	15 min	25 min
		From an organic vehicle	Light	10 min	10 min	10 min	18 min

*Assuming normal duty uniform and relatively local conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

- 1 Minimally operational medical company clearing station includes a receiving and disposition area, emergency treatment area, one OR, CMS, laboratory, X-ray, and one ward.
- 2 Open area means flat ground that does not require further preparation.
- 3 Wooded area means light underbrush that must be cleared but trees do not have to be removed. Times do not include that required for camouflage, or installing stoves and flooring.
- 4 If areas not previously reconnoitered, add 0.5 - 1 hr to times.
- 5 Shorter time based on moderate workload; longer time (computed) based on heavy workload. (Applies to all time ranges given).
- 6 Add 25-30% more time for those portions of operations conducted at night.
- 7 Patients being received are only referred to another facility. Other patients are being evacuated.
- 8 Only that portion of unit required to establish operations at a new site disestablished.
- 9 Capable of receiving and treating patients to a level of care designed for a BAS.
- 10 Minimum tasks that must be performed before a unit can be classified as combat ready.
- 11 M51 shelter is not erected unless a chemical attack is expected and the area is to be occupied in excess of 6 - 8 hours.
- 12 Times do not include the establishment of a helicopter landing area.
- 13 Tentage is not erected unless the occupation of the area is expected to be in excess of 8 - 10 hours, or there is a need for protection from inclement weather.
- 14 Minimum tasks that must be performed before a unit can be classified as having attained Level 2 proficiency.
- 15 To load equipment, prepare patients for evacuation, and be ready to move to new location.

TABLE 9a- Performance Degradation Data for Medical Service Units in a Chemical Warfare (CW) Environment.**

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Medical Service Detachment, 8 people, usually 2 men/team	Preventive medicine inspection (1)	Basic, company size unit	Moderate	.5 day	.5 day	.5 day	1 day
	Mosquito survey (2)	Battalion size unit	Moderate	2 days	2 days	2 days	3 days
	Inspect water points	For Division size element	Moderate -	1.5 days (3)	1.5 days	1.5 days	2 days
	Investigate outbreak of disease	Division size area	Moderate	1 day	1 day	1 day	1.5 days
		Interview people, both sick and well	Light	1 day	1 day	1 day	1.5 days
		Develop statistics	Light	1 day	1 day	1 day	1.5 days
		Investigate causes; initiate corrective actions	Moderate - Light	1 day	1 day	1 day	1.5 days
	Inspect ration break - down points	Within Division	Moderate - Light	.5 day	.5 day	.5 day	1 day
	Spray personnel for lice problem	Battalion size unit	Moderate	1 day	1 day	1 day	1.5 days
	Inspect landfill		Moderate	.5 day	.5 day	.5 day	1 day
	Inspect hospital		Moderate	1 day	1 day	1 day	1.5 days
	Maintenance, PM, jeep-type vehicle	Normal	Moderate - Light	10 min	10 min	10 min	15 min
				inappropriate under MOPP 4 conditions;			

**Reference 27 suggested that several of these tasks would be more involved in preventing heat stress.

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

- (1) Includes inspection of kitchen, garbage disposal, latrines, insect/rodent control, water treatment, laundries, and check of immunization of personnel.
- (2) Includes collection of mosquitoes and larvae, identify specimens, and recommend control operations (spray, drain standing water, cut grass, etc.).
- (3) One day to do survey; one-half day to perform analyses (after collection).

TABLE 10 - Performance Degradation Data for Military Police in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	0°F (10°C)	085°F (29°C)
Variable (1)	Convoy escort (2)	Ammunition convoy	Light/Moderate	N/A (3)	N/A	N/A	N/A
	Traffic control	At intersections	Moderate	N/A	N/A	N/A	N/A
		At river crossings	Moderate	N/A	N/A	N/A	N/A
	Provide security, rear areas	Respond to infiltrators	Moderate	N/A	N/A	N/A	N/A
	Provide security, command post		Moderate	N/A	N/A	N/A	N/A
	Prisoner escort	To POW camp	Moderate	N/A	N/A	N/A	N/A
	Guard POWs	At collection points	Light/Moderate	N/A	N/A	N/A	N/A
	Law enforcement	Within cities/towns	Light/Moderate	N/A	N/A	N/A	N/A
	Straggler control	Civilian population	Light/Moderate	N/A	N/A	N/A	N/A
	Maintain stockade	In war zone	Light/Moderate	N/A	N/A	N/A	N/A
<p>(1) Unit size/number of personnel will vary depending upon the magnitude and severity of the task, e.g., the more POWs captured, the greater the number of guards required; the larger the convoy, the more personnel and vehicles required to provide security; etc.</p> <p>(2) Insure road is open and clear (safe). In cooperation with combat forces.</p> <p>(3) Times are not clearly defined as these functions are essentially continuous. Intensity of effort and duration of effort will vary in proportion to the size of the problem.</p>							

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 11- Performance Degradation Data for Ordnance Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
				@20°F (-7°C)	@50°F (10°C)	@85°F (29°C)
Ammunition Supply Company	Site occupation hasty (1)	Map recon (prior)	Light	30 min	30 min	50 min
		Once site has been selected	Heavy	25 min	75 min	150 min
		Establish security	Heavy	30 min	90 min	180 min
	Site occupation, deliberate (1)	Map recon (prior)	Light	30 min	30 min	50 min
		Physical inspection of site	Light/Moderate	2-2.5 hrs	2-2.5 hrs	3.5-4.3 hrs
Special Weapons Company	Move to a deliberate site, start to finish (2)	Select stockage points	Light/Moderate	30-45 min	30-45 min	50-80 min
		15 km distance	Heavy	6 hrs	12 hrs	36 hrs
		For artillery battery	Heavy	30-45 min	60-90 min	180-270 min
	Distribute ammunition (3)	At night	Heavy	3-3.5 hrs	6-7 hrs	18-21 hrs
		If leave repair items plus any excess materiel	Heavy	4 hrs	8 hrs	24 hrs
Maintenance company (Direct forward support)	Displacement	If take along all materiel	Heavy	24 hrs	48 hrs	144 hrs
		Occupy new area	Heavy	3 hrs	6 hrs	18 hrs
		Change power pack in M113 APC	Heavy	3 hrs	6 hrs	18 hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 11 (continued). Performance Degradation Data for Ordnance Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
				@20°F (-7°C)	@50°F (10°C)	@85°F (29°C)
Maintenance Unit company-size (124 people)	Change power pack in M113 APC	w/ untrained 3-man team	Heavy	6 hrs	12 hrs	36 hrs
	Change cannon	155mm towed howitzer, untrained team (4)	Heavy	3-4 hrs	6-8 hrs	18-24 hrs
		w/trained team	Heavy	2-2.5 hrs	4-5 hrs	12-15 hrs
	Change recoil mechanism	155mm, towed howitzer, (5) untrained team	Heavy	8 hrs	16 hrs	48 hrs
	Establish a maintenance unit area	Includes placement of equipment and material, erection of maintenance facilities, and begin process for receiving supported equipment	Heavy	4.5 hrs	13.5 hrs	27 hrs
	Perform technical inspections	M60 series tank by 4 people	Moderate	1 hr max	1 hr max	3 hr max
		M109 howitzer by 4 people	Moderate	1 hr max	1 hr max	3 hrs max
		M151A1 truck by 2 people	Moderate	30 min max	30 min max	90 min max
	Perform direct support repairs	Replace transmission assembly, M60 series tank	Heavy	16.5 man hrs	33 man hrs*	99 man hrs
		Repair engine in M113 series tracked vehicle	Heavy	9.3 man hrs	18.6 man hrs	55.8 man hrs
		Replace clutch disk and pressure plate, 5-ton M52A1 truck tractor	Heavy	7.8 man hrs	15.6 man hrs	46.8 man hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 11 (continued)- Performance Degradation Data for Ordnance Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)	
					020°F(-7°C)	050°F(10°C) 085°F(29°C)
	Perform recovery operations	On mined or terrain stuck vehicle; includes rigging 2.1 mechanical advantage; 4 people	Heavy	32 min	64 min	96 min 192 min
	Provide DX/float service	Process M151A1 carburetor for DX, 1 person	Light	20 min	20 min	35 min
		Process and issue float assets in return for an unserviceable asset, 1 person	Light	60 min	60 min	105 min

(1) Issues can be made immediately, from backs of trucks.

(2) "Normal" requirement; 155mm shells + propellant charges. (If palletized).

(3) About 40-45 vehicles; 5-ton trucks w/12-ton trailers. Convoy speed 25 mph (max).

(4) With a knowledgeable team that does not have a large amount of "hands-on" training.

(5) Includes 3 people + a wrecker + supervisory NCOs.

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 12 - Performance Degradation Data for Quartermaster Units in a Chemical Warfare (CW) Environment.**

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Supply & Service Company Forward Supply Section (FSS) - 18 men	Receive Class I and selected Class IV supplies	On-going mission which depends on the volume and size of supplies	Heavy	Variable	Add 15-20 min/hr of working time	Add 15-20 min/hr of working time	Add ~50 min per hr of working time
	Set up FSS Supply point	Includes tents, tarpaulins, camouflage nets, open storage	Heavy	6-8 hrs (based on mission requirements)	7-9 hours	8-10 hours	10-12 hours
	Receive Class II and selected Class IV and VII supplies, and storage of these items	As with Class I above	Heavy	Variable	Add 15-20 min/hr of working time	Add 15-20 min/hr of working time	Add ~50 min per hr of working time
	Transmit receiving documents to the DMMC	As needed to update DMMC transaction register	Light	3-5 min per transaction	Add 5-10 min per hr of working time	Add 5-10 min per hr of working time	Add ~20 min per hr of working time
	Issue of Class I, II, IV, and VII supplies	Based on amount requested on the issue documents: Class I	Moderate-Heavy	~1000 rations/hr	Add 15-20 min/hr of working time	Add 15-20 min/hr of working time	Add ~30-40 min/hr of working time
FSS-18 men		Class II, IV, VII		~2-4 short tons/hr	Add 15-20 min per hr of working time	Add 15-20 min per hr of working time	Add ~30-40 min/hr of working time
	Receive, store, issue Class III supplies (POL)		Moderate-Heavy	1200 gal/hr	Add 20-25 min/hr of working time	Add 20-25 min/hr of working time	Add 40-50 min per 1200 gals received or issued
	Decontamination of Equipment and/or preparation to move out	To move out only: Class I, Class II, IV, VII, Class III	Heavy	2 hrs 4-6 hours 3-5 hours	+3 hours +4-6 hours +2 hours	+3 hrs (1) +4-6 hours (1) +2 hours (1)	+6 hours +8-12 hours +4 hours

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 12 (continued) - Performance Degradation Data for Quartermaster Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)		
					@20°F(-7°C)	@50°F(10°C)	@85°F(29°C)
Main Supply Platoon Class I and IV Section	Position equipment and materiel		Heavy	4-6 hours	Add 2 hours	Add 4 hours	
	Position tent, dunnage, and other materiel		Heavy	3-5 hours	+1.5 hours	+3 hours	
	Store division reserve stocks	Based on MHE equipment available	Heavy	2-4 short tons per hour	Add 30 min to each hour	Add 50 min to each hour	
	Break bulk (palletized) supplies for storage or issue	Class I	Heavy	2000 rations/hr	Add 30 min/hr	Add 50 min/hr	
	Issue Class I and IV	Class IV As per mission requirement:	Heavy	2 short tons/hr	Add 45-60 min/hr	Add 90-120 min/hr	
Class III Section		Class I	Heavy	3-4000 rations per hour	Add 15 min/hr	Add 50 min per hour	
	Prepare terrain and establish the Fuel System Supply Point	Class IV	Heavy	4-5 short tons per hour	Add 30-45 min/hr	Add 45-60 min/hr	
	10,000 gal system w/ 350 GPM pump		Heavy	6-8 hours	Add 2 hours	Add 4 hours	
	Fuel a 30-vehicle convoy						
Class II, IV, and VII Section	Store supplies, unclassified maps, and division reserve stocks	In support for division size, with MHE capability	Heavy	~ 1 hour	Add 15 min/hr	Add 30 min/hr	
			Heavy	~ 18-24 hours	Add 4-6 hours	Add 8-10 hours	

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 12 (Continued) - Performance Degradation Data for Quartermaster Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)		
					@20°F (-7°C)	@50°F (10°C)	@85°F (29°C)
Central Issue Facility (CIF)	Issue Class II, IV, and VII supplies	With MHE	Heavy	12-14 short tons/hr	Add 2-4 hours	Add 2-4 hours	Add 4-6 hours
	Prepare Class II and selected Class IV and VII items for shipment	Document, packaging, palletizing	Heavy	8-9 short tons/hr	Add 1.5-3 hrs	Add 1.5-3 hrs	Add 3-5 hrs
	Establish the salvage collection point	For division	Heavy	4-6 hours	Add 1-1.5 hours	Add 1-1.5 hours	Add 2-3 hours
	Position tents, dunnage, and administrative equipment		Heavy	2-3 hours	Add 45-60 min	Add 44-60 min	Add 1.5-2 hours
	Position CIF stocks (clothing, TA-50, etc.)		Heavy	4-5 hours	Add 1-2 hours	Add 1-2 hours	Add 2-4 hours
	Receive clothing and equipment from a company size unit, i.e., turn-ins	Based on 3 sets of clothing per man for a 250-man company	Moderate-Heavy	2-3 hours	Add 45-60 min	Add 45-60 min	Add 1.5-2 hours
Clothing Exchange & Bath Section (CEB)	Issue of new clothing for above unit plus equipment (TA-50)	Based on 3 sets of clothing per man for a 250-man company	Moderate-Heavy	2-3 hours	Add 45-60 min	Add 45-60 min	Add 1.5-2 hours
	Establish undressing, delousing, bathing, and dressing areas	By an 8-man team	Heavy	2.5-3 hours	Add 1-1.5 hrs	Add 1-1.5 hrs	Add 2-3 hrs
	Position clothing exchange stocks		Heavy	1-2 hours	Add 30 min	Add 30 min	Add 45-60 min
	Connect bath equipment, 3000-gal blivet, hoses, pump, pallets, etc.	By an 8-man team	Moderate-Heavy	1.5-2 hours	Add 0.75-1.25 hours	Add 3/4-1 1/4 hours	Add 1-1.5 hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 12 (continued) - Performance Degradation Data for Quartermaster Units in a Chemical Warfare (CW) Environment*

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Graves Registration, Collection, Identification and Evaluation Section (GRREG)	Prepare drainage system (Heavy labor, ditch digging)	Under normal conditions	Heavy	1 hour	Add 1 hour+	Add 1 hour+	Add 2 hours+
	Operate shower equipment	For 8 men to go through	Moderate	8-10 min	15-20 min (2)	15-20 min (2)	Add 20-45 min
	Position tents and equipment		Heavy	3-4 hours	Add 1 hour	Add 1 hour	Add 2 hours
	Receive remains		Moderate	5-10 min/body	Add 5 min+ time to decontaminate remains (1 hr)	Add 5 min+ time to decontaminate remains (1 hr)	Add 10 min+ time to decontaminate remains (2 hrs)
	Identify remains	Based on condition and identification available	Light	5 min-hrs	Add minimum of 1/3 more time per body	Add minimum of 1/3 more time per body	Add minimum of 50% more time per body
	Inventory personal effects		Light*	5-10 min/body	Add 3-5 min	Add 3-5 min	Add 6-10 min per body
Supply and service company (SSS)	Load and evacuate remains to a mortuary or to a temporary cemetery		Light-moderate	5-10 min/body	Add 5 min/body	Add 5 min per body	Add 10 min/body
	Establish perimeter defense: Wire, foxholes, barriers, mines, etc.	Based on each of above sections being assigned a section of the perimeter	Heavy	8-10 hrs	Add 4-6 hrs	Add 4-6 hrs ⁽³⁾	Add 6-8 hrs
	Camouflage area (natural + nets)	Same as above	Heavy	4-6 hours	Add 1-2 hours	Add 1-2 hours	Add 2-4 hours

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

1. Times reflect both decontamination of equipment and preparation to move out.
2. Time includes that required to decontaminate.
3. To include good overhead cover and protected positions.

*This table was prepared entirely by CPT Andrew W. Knight, USATECOM, APG, MD.

TABLE 13 - Performance Degradation Data for Signal Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
Artillery Combat Battalion	Establish communications	Wire ⁽¹⁾ FM ⁽²⁾ Erect antenna (RC-292) AM ⁽³⁾	Heavy	<2 hours	<4 hours	<12 hours
				<30 min	<60 min	<3 hours
				<15 min	<30 min	<1.5 hours
				<1 hour	<2 hours	<6 hours
				2 hrs max.	4 hrs max.	12 hrs max.
Artillery Group HQ	Establish communications to Battalion, 31 mile	Wire Multichannel ⁽⁴⁾ Time of alert till begin to move Become operational at new site	Heavy	2 hrs max.	4 hrs max.	12 hrs max.
				3-4 hours	6-8 hours	18-24 hours
				2 hrs max.	4 hrs max.	12 hrs max.
				2 hrs max.	4 hrs max.	12 hrs max.

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 13 - (Continued) Performance Degradation Data for Signal Units in a Chemical Warfare (Cw) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Signal Bn	Establish communications (VHF) between Div Main, Div Arty, Tac CP, and forward Brigades (Each link a 12 channel system)	Minimum number of links to "fight the war."	Heavy	2 hrs max	4 hrs max	6 hrs max	12 hrs max
		Complete	Heavy	12 hrs max	24 hrs max	36 hrs max	72 hrs max
		Set up station	Heavy	.5 hr	1 hr	1.5 hrs	3 hrs
		Get into net	Heavy - Moderate	1 hr	2 hrs	3 hrs	6 hrs
	FM Station (Div - CG Cmd Net and Ops/Intel Net)	Set up station w/RC-292 antenna w/whip antenna	Heavy Heavy	.5 hr 15 min	1 hr 30 min	1.5 hr 45 min	3 hrs 1.5 hr
		Get into net w/RC-292 antenna w/whip antenna	Heavy - Moderate Heavy - Moderate	1 hr .5 hr	2 hrs 1 hr	3 hrs 1.5 hrs	6 hrs 3 hrs
	Lay cable within Div Main Area (from Patch Panel (SB611))	Cable (26 pair) Wire (1 pair)	Heavy Heavy	4 hrs max 2 hrs max	8 hrs max 4 hrs	12 hrs max 6 hrs max	24 hrs max 12 hrs max
	(1) Lay wire from Bn FDC to Batteries; usually less than 1 mi (usually in hundreds of yards).						
	(2) Erect antenna, connect to radio, open the net.						
	(3) Erect doublet antenna, hook up generator, come into the net.						
	(4) Erect large antennas (horn, hydraulic type), perform alignment, get on correct frequency.						

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 14 - Performance Degradation Data for Transportation Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	985°F (29°C)
Aviation Intermediate Maintenance Company ⁽¹⁾	Aircraft maintenance	Periodic inspection	Moderate - Heavy	Variable	Variable	Variable	Variable
		Change engine	Heavy	1-3 days ⁽²⁾	2-4 days	2-4 days	3-5 days
		Phase inspection	Moderate - Heavy	2-7 days	3-8 days	3-8 days	4-10 days
		Test flight	Moderate	1 hr	1 hr	1 hr	3 hrs
		Avionics, check	Moderate	15-30 min	15-30 min	15-30 min	45-90 min
		Avionics, trouble-shoot	Moderate	1-2 hrs	1-2 hrs	1-2 hrs	3-6 hrs
		Change rotor blades:					
		To remove	Heavy	2-4 hrs	4-8 hrs	6-12 hrs	12-24 hrs
		To replace	Heavy	2 hrs	4 hrs	6 hrs	12 hrs
		Blade balance	Moderate	1/2-1 hr	1/2-1 hr	1/2-1 hr	1/2-1 hr
		Blade track	Moderate	45 min	45 min	45 min	135 min
	Aircraft recovery ⁽³⁾	Ground check		30 min	30 min	30 min	1.5 hrs
		Test flight		15 min	15 min	15 min	45 min
		Time on site ⁽⁴⁾	Heavy	1 hr	2 hrs	3 hrs	6 hrs
		Preparation for removal	Heavy	20 min	40 min	60 min	120 min

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 14 (continued) - Performance Degradation Data for Transportation Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4(FULL PROTECTIVE ENSEMBLE)		
					@20°F(-7°C)	@50°F(10°C)	@85°F(29°C)
	Move to new site, with in 50-100 miles of support units (5)	Prepare to move	Heavy	1 day	2 days	3 days	6 days
		Actual movement	Moderate	1 day	1 day	1 day	3 days
		Become operational (6)	Heavy	1-2 days	2-4 days	3-6 days	6-12 days
<p>(1) Consists of 250-300 men, 4 platoon elements, operating from a semi-fixed facility.</p> <p>(2) Time required depends on type of airframe.</p> <p>(3) Uses CH-47 + 10-man rigging crew + UH-1. Crew goes out and prepares aircraft for recovery; CH-47 comes in, hooks up, removes.</p> <p>(4) Travel time varies w/distance.</p> <p>(5) Unit operates at a 50-100 mile range of supported units. When move is made, the 50-100 mile range will usually be maintained.</p> <p>(6) Could actually operate from 2 sites (old and new) for period of 1 week (until finish previously started repairs).</p>							

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

Table 14a - Performance Degradation Data for Transportation Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					@20°F (-7°C)	@50°F (10°C)	@85°F (29°C)
TRANSKOM (Transportation Command)	Command and control of transportation units w/in theater (except MCA)	Staff assistance; coordination of transport services	Light	Continuous	N/A (1)	N/A (1)	N/A (1)
Transportation Movement Control Agency (MCA)	Operate Movement Control Centers (MCC)	Control movement of personnel and materiel in COMMZ; Perform highway traffic regulation w/in COMMZ	Light	Continuous	N/A (1)	N/A (1)	N/A (1)
COSCOM MCC	Command and control of Motor Trans. Bn.	Staff assistance; control movement of personnel and materiel w/in corps area.	Moderate	Continuous	N/A (2)	N/A (2)	N/A (2)
Transportation Motor Group:	Command and control of motor Bns.	Staff assistance; coordinate transportation; supervise transportation	Light	Continuous	N/A (1)	N/A (1)	N/A (1)
S2/S3	Operations and training	(a) Route recon (b) Movement Plans	Heavy	2-4 hrs	N/A	N/A	N/A
S ⁴	Motor Maintenance	Maintenance procedures (general supervision of maintenance w/in motor Bns)	Moderate	5-8 hrs	4-8 hrs	6-12 hrs	12-24 hrs
Medium Truck Company	Resupply of tactical and non-tactical units	Short haul operations	Moderate	6-8 hrs	6-8 hrs	6-8 hrs	18-24 hrs
	Vehicle driver	(a) Receive cargo (b) Deliver cargo	Heavy	Continuous	N/A (3)	N/A (3)	N/A (3)
			Moderate	Continuous	N/A (3)	N/A (3)	N/A (3)
				1-2 hrs	1-2 hrs	1-2 hrs	3-5 hrs
				6-8 hrs	6-8 hrs	6-8 hrs	18-24 hrs

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

Table 14a - (continued) - Performance Degradation Data for Transportation Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS			
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)		
					020°F (-7°C)	050°F (10°C)	085°F (29°C)
Medium Truck Company	Vehicle driver	(c) Off load (d) Maintenance	Moderate Moderate	1-2 hrs 1-2 hrs	1-2 hrs 1-2 hrs	1-2 hrs 1-2 hrs	3-6 hrs 3-6 hrs
	Platoon HQ	Coordinate cargo receipt Accompany Movement Off load	Moderate Moderate Moderate	1-2 hrs 6-8 hrs 1-2 hrs	1-2 hrs 6-8 hrs 1-2 hrs	1-2 hrs 18-24 hrs 3-6 hrs	3-6 hrs 3-6 hrs
Transportation Terminal Group	Command and Super-vise Terminal Bns	Staff assistance; coordinate services; supervise operations	Light to Moderate	Continuous	N/A ⁽⁴⁾	N/A ⁽⁴⁾	N/A ⁽⁴⁾
	Terminal Bn	Command and super-vision of terminal service and terminal transfer companies	Light	Continuous	N/A ⁽⁵⁾	N/A ⁽⁵⁾	N/A ⁽⁵⁾
Transportation Terminal Service Company	Discharge Vessels	(a) 1000 short tons of cargo daily (b) Sort cargo by destination (c) Account for cargo (d) Store cargo	Heavy	Continuous	N/A ⁽⁶⁾	N/A ⁽⁶⁾	N/A ⁽⁶⁾

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

- (1) Personnel not routinely exposed to adverse tactical conditions.
- (2) Personnel of regulating teams could be exposed to significant amounts of contamination. Significant degradation would result and a great impact upon traffic congestion and the efficiency of motor transportation operations could be expected.
- (3) High exposure risk for personnel (drivers). Exposure would likely produce a drastic decrease in rate of resupply and disrupt operations.
- (4) Unit located at major transportation "choke points" (harbors, ports, terminals). Functions are mainly administrative/clerical w/heavy dependence upon data systems and telephonic communications. Personnel not routinely exposed to adverse conditions.
- (5) Personnel routinely exposed to environment; heavily dependent upon data systems and telephonic communications.
- (6) Personnel employed in built-up port areas or in "bare-beach" operations. Exposed to environment; would suffer high degree of degradation if required to operate in an NBC environment. Tasks are labor intensive, constraint of movement would significantly reduce efficiency.

Table 14b - Performance Degradation Data for Transportation Units in a Chemical Warfare (CW) Environment.

TYPE OF UNIT	MAJOR FUNCTION	DESCRIPTION	WORKLOAD	TIMES REQUIRED TO ACCOMPLISH FUNCTIONS		
				W/O PROTECTIVE CLOTHING*	WHILE IN MOPP 4 (FULL PROTECTIVE ENSEMBLE)	
					020°F (-7°C)	050°F (10°C)
Transportation Motor Transport Bn: Light Truck Co	Move general cargo and personnel; equipped with either 2½ or 5-ton trucks (if) 45 trucks available	Local haul (about 15 mi forward), round trip per truck	Moderate	5 hrs (2)	5 hrs	15 hrs
		Line haul (about 75 mi forward), round trip per truck	Moderate	10 hrs (3)	10 hrs	30 hrs
Medium Truck Co	Move general cargo, bulk POL products, and refrigerated cargo; equipped with 45 semi-trailer combinations (4)	Local haul, about 15 mi forward, round trip per truck	Moderate	5 hrs (2)	5 hrs	15 hrs
		Line haul, about 75 mi forward, round trip per truck	Moderate	10 hrs (3)	10 hrs	30 hrs
Heavy Truck Co	Move tanks and heavy or outsized cargo and vehicles, operating with 18 truck tractors and semi-trailers (5)	Local haul, about 15 mi forward, round trip per truck	Moderate	5 hrs (2)	5 hrs	15 hrs
		Line haul, about 75 mi forward, round trip per truck	Moderate	10 hrs (3)	10 hrs	30 hrs

*Assuming normal duty uniform and relatively local conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

- (1) 2½-ton trucks loaded w/4 tons of cargo or 16 or 20 personnel per truck; 5-ton trucks loaded w/6 tons of cargo or 18 or 20 personnel per truck. On local hauls, both 2½- and 5-ton trucks haul 20 people; on line hauls, 2½-ton truck hauls 16 people and 5-ton truck hauls 18 people
- (2) Based on 4 round trips per day per truck (2 round trips per 10-hr shift, 1 round trip in 5 hours).
- (3) Based on 2 round trips per day per truck or 1 round trip per 10-hr shift.
- (4) 12 tons of cargo per semitrailer, 5000 gallons per tanker, or 6 tons of refrigerated cargo per vehicle.
- (5) Average load of 40 tons per truck.

TABLE 15 - CYCLIC WORK/REST VALUES (MINUTES) WITH NEGLIGIBLE HEAT CASULTIES.⁽¹⁾

MOPP LEVEL	WORK RATE	TEMPERATURE RANGES			
		21 ⁰ C (70 ⁰ F)	21-26 ⁰ C (70 ⁰ -79 ⁰ F)	27-32 ⁰ C (80-89 ⁰ F)	33 ⁰ C (90 ⁰ F)
1	Low	(2)	(2)	(2)	(2)
	Moderate	(2)	(2)	60/20	40/50
	Heavy	(2)	60/15	40/25	30/50
2	Low	(2)	(2)	(2)	50/50
	Moderate	(2)	(2)	50/35	30/60
	Heavy	60/30	45/30	25/30	(3)
3	Low	(2)	(2)	(2)	60/30
	Moderate	(2)	60/20	40/35	30/50
	Heavy	40/20	35/30	(3)	(3)
4	Low	(2)	(2)	40/30	20/50
	Moderate	40/20	30/25	20/40	(3)
	Heavy	20/25	(3)	(3)(10/50)*	(3)

(1) Data extracted from Table 5-2, page 5-12, of FM 21-40, C1, dated 14 October 1977 (Reference 8).

(2) Under these conditions any reasonable work/rest periods will suffice to prevent heat casualties.

(3) Under these conditions work time will be severely limited, and even very short periods of heavy work could result in heat casualties.

*Estimated value employed in calculations.

TABLE 16 - WORK/REST TIMES (MINUTES)⁽¹⁾

<u>TEMPERATURE</u>	<u>WORK LOAD</u>	<u>BASELINE⁽²⁾</u>		<u>MOPP 4</u>	
		<u>WORK TIME</u>	<u>REST TIME</u>	<u>WORK TIME</u>	<u>REST TIME</u>
-7°C (10°F)	LIGHT	NHB ⁽³⁾	15	NHB	20
	MODERATE	NHB	15	NHB	30
	HEAVY	NHB	15	30	30
10°C (50°F)	LIGHT	NHB	15	NHB	30
	MODERATE	NHB	15	NHB	50
	HEAVY	NHB	15	25	50
29°C (85°F)	LIGHT	180	20	60	∞
	MODERATE	90	50	40	∞
	HEAVY	25	70	15	∞

(1) Data extracted from Appendix H, Annex III, 61 JTCG/ME-75-13, pages H-56, H-57, and H-58 (Reference 24).

(2) Uniform is that normally worn in keeping with conditions; no NBC protection.

(3) NHB - No heat build-up; personnel can work for 2 hours or more and not build up sufficient heat to be degraded.

Table 16 provides a compilation of work/rest times extracted from Annex III to Appendix H of Report 61 JTCG/ME-75-13.²⁴ The data evolved from the Project MANDRAKE ROOT Addendum Study and are based solely upon heat stress. Allowable work time was derived by means of a calculation that considered the hourly heat build-up in man and the maximum allowable heat before stress conditions occur in man. Required rest time was calculated by taking into consideration the hourly heat build-up factor and the total heat loss due to wearing a particular protective ensemble. The work and rest times are absolute estimates. The amount of heat output associated with the designations of light, moderate, and heavy work loads are 150 Kcal/hr, 200 Kcal/hr, and 400 Kcal/hr, respectively.

Attempts to quantify the effects of factors other than heat stress have been hampered by a lack of empirical data,²⁵ and thus were not employed here. Among these other factors were visual acuity, respiratory stress, manual dexterity, and psychological effects.

The work/rest times shown in Tables 15 and 16 were applied to the function/time data of Tables 2-14, except in the case of the Quarter-master Units (Table 12)²⁵, and in the case of the TOW crew (Table 8a)²⁶. The manner in which this was done was essentially to add the recommended rest times to the time given as being required to accomplish the task without CW protective gear (for the appropriate workload and temperature). As examples, if the time required to perform a task requiring a heavy workload without CW gear was given as 60 minutes under relatively ideal conditions, the times to perform the same function at 20, 50 or 85°F (-7, 10 or 29°C) while in MOPP 4 were calculated as follows:

- At 20°F (-7°C), the cycle to complete the task consisted of 30 minutes of work plus 30 minutes of rest, followed by 30 minutes of work and an additional 30 minutes of rest. The total time calculated was 120 minutes, twice that expected to complete the task without the encumbrance of CW protective clothing.
- At 50°F (10°C), the cycle to complete the task consisted of 25 minutes of work followed by 50 minutes of rest, another 25 minutes of work followed by 50 minutes of rest, and finally 10 minutes of work followed by a 20 minute rest period. The total time calculated to complete the task was 180 minutes, three times the expected time under normal conditions.
- At 85°F (29°C), no work/rest times were given. Therefore, an extrapolated value was incorporated into Table 15 and employed in the calculations. It was decided to use a 50 minute rest period for every 10 minutes of heavy work. (This 10/50 value is probably conservative and the situation is likely to be worse, i.e., more time to rest and recover will be necessary.) Thus, the total time calculated to complete the example task was 360 minutes, six times that normally required.

Calculations of times were made in a similar manner for all the tasks in Tables 2-14, except for those mentioned earlier (i.e., Quartermaster Units and TOW Crew, Tables 12 and 8a, respectively).

Examination of Tables 2-14 indicates a significant increase in the time required to perform tasks while in full MOPP, and that a tremendous increase in time can be expected to complete those tasks requiring heavy workloads at high temperatures. During the work period the actual work time may in reality increase due to a decrease in efficiency. The result would be that more rest time would be required. Therefore, the computed times represent a probable minimum amount of time that²⁷ may be required to accomplish these tasks, and will likely be higher.

It should be noted that the computed times do not take into account staggered or rotated work assignments, or allocating more people to those tasks considered to be especially critical (assuming that a source of additional manpower was available). The times do include a rest period after the final work period to enable personnel to recover so they can perform their next task.

Another point to consider, but which is not reflected in the tables of computed data, is that if it were known that a unit was to be replaced at a specified time, the personnel could work to a point of exhaustion, and not have to regulate their level of work to be able to perform additional tasks later. The data in Table 17 (from FM 21-40)⁶ provide guidance toward determining the duration of sustained periods of work before the onset of significant heat casualties.

4. SUMMARY

The program to date can be summarized as follows:

- A search of the literature revealed a scarcity of quantitative data of the type desired. A large portion of the data was of a subjective nature, while most of the quantitative data was based solely upon heat stress with little or no consideration of other factors such as manual dexterity, visual acuity, or psychological factors.
- Partial task (function)/workload information has been compiled for several branches of the Army. Additional and revised data will be incorporated into the program as they become available; quantified test data will replace calculated data as tests are developed and performed.
- Degradation times for these tasks (functions) have been computed by using the best data currently available, viz., the work/rest times presented in Tables 15 and 16 of this report.

This report has described the initial efforts directed toward establishing and developing a data base which can be utilized to generate meaningful and realistic degradation data through computer simulations. Since this effort has not been completed but will be updated and revised in the future, no conclusions have been made at this time.

TABLE 17 - MAXIMUM TIMES (MINUTES) WITH MINIMUM HEAT CASUALTIES. (1)

MOPP LEVEL	WORK RATE	TEMPERATURE RANGES			
		21°C (70°F)	21°-26°C (70°-79°F)	27°-32°C (80°-89°F)	33°C (90°F)
1	Low	(2)	(2)	(2)	(2)
	Moderate	(2)	(2)	(2)	100
	Heavy	(2)	(2)	110	50
2	Low	(2)	(2)	(2)	(2)
	Moderate	(2)	(2)	(2)	65
	Heavy	(2)	170	65	45
3	Low	(2)	(2)	(2)	(2)
	Moderate	(2)	(2)	140	55
	Heavy	200	95	55	40
4	Low	(2)	(2)	(2)	80
	Moderate	(2)	115	65	40
	Heavy	60	50	40	30

(1) Data extracted from Table 5-4, page 5-16, FM21-40, C1, dated 14 October 1977 (Reference 8).

(2) Under these conditions, fatigue caused by exertion will probably be the limiting consideration rather than body heat buildup.

5. FURTHER EFFORTS/RECOMMENDATIONS

It should be emphasized that the computations presented herein are based upon the best information currently available. This is to say these data should not be considered as final, but only that there is nothing better at this point in time. It is anticipated that where impractical times have been presented, more realistic data will be obtained, either from published reports not yet located or from personnel with first hand knowledge or experience (test/training participants).

Further efforts will continue to be directed toward updating and expanding the data as it becomes available. Times will be revised to reflect more realistic situations. Tasks (functions) will be expanded as more information is collected. Degradation times will be computed where necessary. An updated version of the data contained in this report is planned in approximately 6 months.

To obtain valid data to support this effort the following recommendations are offered:

- Training exercises, field exercises, etc., should be conducted with and without CW protective gear.
- Tests should be conducted to determine the degree of improvement in effectiveness or efficiency as a function of the number of times tasks are performed while in CW protective gear.
- Accurate measurements of such variables as time, accuracy, rate of fire, probability of hit, ability to acquire targets, etc., should be made. Determine the differences in these parameters with and without CW protective gear.
- Data should be acquired for major battlefield systems and weapons (e.g., IFV, CFV, ITV, 60 mm and 81 mm mortars, VIPER, TOW, etc.).
- As much data as possible should be obtained from field commanders and should not reflect "sterile" test conditions. Data should be "honest" and not be that which makes the unit look good.
- Intermediate MOPP levels should be studied in more detail.
- The effect of acclimatization should be studied to determine if training will significantly reduce degradation and if so, by how much. As a corollary, examine the effects of physical conditioning.

- Tests should be conducted in various climates with emphasis on those where a substantial threat exists.
- Cold weather operations should be studied to determine if any degradation occurs from the cold weather clothing by itself, and what effects are produced by wearing CW protective gear in a cold environment.
- Tests should be conducted for extended periods of time (6 hours) to determine the extent of degradation as a function of time.
- Tests should be conducted to provide data for situations in which personnel are fresh (rested) and fatigued, with and without protective ensembles.
- Where necessary, a series of "mini-tests" should be designed to provide empirical data for inclusion in this program. Such tests might be performed by the US Army Combat Developments Experimentation Command under the direction of HQ TRADOC.

REFERENCES

1. R. F. Goldman, "Tolerance Time for Work in the Heat When Wearing CBR Protective Clothing", Military Medicine, Vol. 128, No. 8, 776-786, August 1963.
2. P. F. Iampietro and R. F. Goldman, "Tolerance of Men Working in Hot, Humid Environments", J. Appl. Physiology, Vol. 20, No. 1, January 1965.
3. R. F. Goldman, "Energy Expenditure of Soldiers Performing Combat Activities", Ergonomics, Vol. 8, No. 3, 321, July 1965.
4. R. J. T. Joy and R. F. Goldman, "A Method of Relating Physiology and Military Performance: A Study of Some Effects of Vapor Barrier Clothing in a Hot Climate", Military Medicine, Vol. 133, No. 6, 458-470, June 1968.
5. H. DeV. Martin and R. F. Goldman, "Comparison of Physical, Biophysical and Physiological Methods of Evaluating the Thermal Stress Associated with Wearing Protective Clothing", Ergonomics, Vol. 15, No. 3, 337-342, 1972.
6. R. F. Goldman and J. R. Breckenridge, "Current Approaches to Resolving the Physiological Heat Stress Problems Imposed by Chemical Protective Clothing Systems," Proceedings, Army Science Conference, 1976.
7. R. G. Soule, K. B. Pandolf, and R. F. Goldman, "Voluntary March Rate as a Measure of Work Output in the Heat", Ergonomics, Vol. 21, No. 6, 455-462, 1978.
8. FM 21-40, C1, NBC Defense, Headquarters, Department of the Army, Washington, DC, 14 Oct 1977.
9. J. D. Claiborne, Mathematical Modeling of Personnel Degradation, Volume 1. Background Information and Theory, ARCSL-CR-79071, Chemical Systems Laboratory, Aberdeen Proving Ground, MD, Dec 1979. (Unclassified Report)
10. ROAD Battalion Operations in a Toxic Environment (U), Volume 1 of 3, Operational Capability Experiment, US Army Combat Developments Command Experimentation Center, Ft. Ord, CA, dated Dec 1963. (Unclassified Report)
11. Mission Degradation Resulting From Chemical Protective Postures, PROJECT SUMMIT (U), US Army MUCOM Operations Research Group, Edgewood Arsenal, MD, dated Apr 1967. (Secret Report)
12. Addendum Study, Project MANDRAKE ROOT, A Tactical Chemical-Biological Operations Study (U), US Army Combat Developments Command, Ft. McClellan, AL, dated Jun 1967. (Secret Report)

13. Field Evaluation, Mission Effectiveness in a Toxic Environment (METOXE), Final Report, 5th Infantry Division (Mechanized), conducted at Ft. Carson, CO, 19 Sep-14 Nov 1968. (Unclassified Report)
14. Final Report, Troop Test Mission Effectiveness in a Toxic Environment METOXE II, 5th Infantry Division (Mechanized), Ft. Carson, CO, Oct 1969. (Unclassified Report)
15. Field Evaluation Mission Effectiveness in a Toxic Environment METOXE I - Maintenance, HQ, 1st Infantry Division (Mechanized), Ft. Riley, KS, Jul 1971. (Unclassified Report)
16. CPT James B. Cross, Individual Research Project, Degradation of Performance Due to Wear of Protective Clothing and Equipment (U), Ordnance Advanced Course, C22-#2, Section H, 1975. (Confidential)
17. GRAND PLOT III, Final Report, Volume I and Supplement to Volume I, HQ, US Army Combat Developments Experimentation Command, Ft. Ord, CA, Mar 1976. (Secret Report)
18. GRAND PLOT III (USACDEC Experiment FC 027), Evaluation Report, USAOC&S Project No. 76-GP III-002, September, 1976. (Secret)
19. J. L. Carr, B. M. Corona, S. E. Jackson, and V. L. Bachovchin, The Effects of Chemical Biological Clothing and Equipment on US Army Soldier Performance: A Critical Review of the Literature (A Preliminary Survey), Technical Memorandum 12-80, USA Human Engineering Laboratory, Aberdeen Proving Ground, MD, 21005, July 1980. (Unclassified Report)
20. J. L. Carr, R. L. Kershner, B. M. Corona, and S. E. Jackson, The Effects of CB Clothing and Equipment on US Army Soldier Performance: A Critical Assessment of Performance Testing, Technical Memorandum 25-80, USA Human Engineering Laboratory, Aberdeen Proving Ground, MD, 21005, November 1980. (Unclassified Report)
21. Techniques for War Game Assessment of Chemical Operations, Final Report, BDM/CARAF-FR-76-033, BDM Company, Combined Arms Research and Analysis Facility, Leavenworth, KS, Sep 1976. (Unclassified Report)
22. IDA Tactical Warfare Model: A Theater-Level Model of Conventional, Nuclear, and Chemical Warfare, Volume III, Part I, WSEG Report 275, Institute for Defense Analyses, Arlington, VA, Nov 1977. (Unclassified Report)
23. Studies of Liquid Agent Detector (LAD) Devices, Volume I: Preliminary Evaluation of LAD Employed in Selected Scenarios, ARCSL-CR-78018, Calspan Corp., Buffalo, NY, Nov 1977. (Confidential Report)

24. Chemical Agent Decontamination Study, 61 JTCG/ME-75-13, Joint Technical Coordinating Group for Munitions Effectiveness, Aberdeen Proving Ground, MD, Mar 1977. (Secret Report)
25. Table prepared by CPT Andrew W. Knight, HQ TECOM, APG, MD, July 1980.
26. Letter, ATSH-CD-MS-C, dtd 20 Feb 1981, subject: "Effect of Chemical Protective Clothing on Combat Efficiency" w/Inclosure (Letter ATSH-W-D, dtd 18 Dec 1980, subject: "Test of TOW Crew Operating on the M113A1 (TOW) with MOPP (Mission Oriented Protective Posture) Equipment.")
27. Message, R1216022 Feb 81, Cdr, HSC, HSOP-SO, subject: "The Effect of Chemical Protection Clothing and Equipment on Combat Efficiency".

DISTRIBUTION LIST

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	HQDA (DAMA-ZD) WASH, DC 20310	1	Office of the Under Secretary of Defense for Research & Development (ELS) ATTN: Mr. T. E. Dashiell Pentagon - Rm 3D129 Washington, DC 20301
1	HQDA (DAMI-FIT) WASH, DC 20310		
1	HQDA (DAMO-ZD) WASH, DC 20310	1	DUSA (OR) ATTN: Dr. H. Fallin Washington, DC 20301
1	HQDA (DALO-SMZ) WASH, DC 20310	1	Commander US Army Training & Doctrine Command ATTN: ATCD-2 (COL J. Mojecki) Fort Monroe, VA 23651
1	HQDA (DAEN-ZB) WASH, DC 20310		
1	HQDA (DAMO-HCC/COL Robinson) WASH, DC 20310	1	Commander US Army Concepts Analysis Agency ATTN: CSCA-RQN (COL Makowski) 8120 Woodmont Avenue Bethesda, MD 20014
1	HQDA (DAMA-CSS-C) WASH, DC 20310		
1	HQDA (DASG-HCD/MAJ Beckey) Pentagon, RM 2D515 WASH, DC 20310	1	US Marine Corps Office of Deputy Chief of Staff for Operations & Training Ground Combat Requirements Section ATTN: Code OTDG31 (MAJ B. C. Henry) Washington, DC 20380
3	Commander US Army Materiel Development & Readiness Command ATTN: DRCNC (LTC Pittman) DRCDE-DM DRCQA-PA 5001 Eisenhower Avenue Alexandria, VA 22333		
1	Joint Chiefs of Staff ATTN: J-5 Washington, DC 20301	1	HQ USAF ATTN: AF X00TA Pentagon Washington, DC 20330

DISTRIBUTION LIST (CONT'D)

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	Commander US Army Armament Materiel Readiness Command ATTN: DRSAR-PE Rock Island, IL 61299	1	HQ USAF ATTN: AF XO XF Pentagon Washington, DC 20330
1	Director USANCA ATTN: MONA-SAL 7500 Backlick Road Springfield, VA 22150	5	Commander US Army Military Police & Chemical Schools Training Center ATTN: ATZN-CM-AC ATZN-CM-CDC (MAJ Schultz) ATZN-CM-CDC (LTC Colclasure) ATZN-CM-CS (LTC Jones) ATZN-MP-CMM (MAJ McCammon) Fort McClellan, AL 36205
2	Commandant Academy of Health Sciences ATTN: HSA-IHE HSA-CDB (CPT Connock) Ft. Sam Houston, TX 78234	1	Commander US Army Engineer School ATTN: ATZA-CD Fort Belvoir, VA 22060
1	Commander HQ, Health Service Command ATTN: HSOP-S Ft. Sam Houston, TX 78234	2	Commander US Army Infantry School ATTN: ATSH-CD-MS-C (CPT Harris) ATSH-W-D Fort Benning, GA 31905
1	HQSAMRDC ATTN: Combat Casualty Care Ft. Detrick Frederick, MD 21701	2	Commander US Army Aviation Center & School ATTN: ATZQ-D-T ATZQ-D-M (CPT Savage) Ft. Rucker, AL 36360
1	Commandant US Army Quartermaster School ATTN: ATSM-CDM Fort Lee, VA 23801	1	Commander US Army Intelligence School ATTN: Cml Officer Ft. Huachuca, AZ 85613
1	Commandant US Army Transportation School ATTN: ATSP-CD-D Fort Eustis, VA 23604	1	Commander US Army Ordnance Center & School ATTN: ATSL-CD-SA (Mr. Miller) Aberdeen Proving Ground, MD 21005
1	Commander US Army Armor School ATTN: ATZK-CSD CPT Aiken Fort Knox, KY 40121	1	Commander US Army Combined Arms Center and Ft. Leavenworth ATTN: ATZL-CAD-LN (LTC Haskins) Ft. Leavenworth, KS 66027
1	Commandant US Army Field Artillery School ATTN: ATSF-CA-NW (MAJ Bowers) Fort Sill, OK 73503	1	Commander NBC Defense School ATTN: AFZI-PTS-TC Ft. George G. Meade, MD 20755

DISTRIBUTION LIST (CONT'D)

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
2	Commander US Army Tank Automotive Command ATTN: DRSTA-NR (LTC Brake) DRSTA-SA Warren, MI 48090	1	Commander US Army Readiness Group ATTN: CML Staff, Bldg 44 Ft. Sam Houston, TX 78234
1	Director Combat Developments Test & Evaluation Office ATTN: ATZK-CD-TE (MAJ D. McDonnell) Fort Knox, KY 40121	1	Commander US Army Readiness Region VIII ATTN: AFKC-RRA-OPDD Fitzsimmons Army Medical Center Aurora, CO 80045
6	Commander US Army Combined Arms Training Development Activity ATTN: ATZLCA-CA ATZLCA-DL ATZLCA-CO ATZLCA-SW ATZLTDA-DS ATZLTDA-AD Fort Leavenworth, KS 66027	1	Commander US Army Readiness Region IX ATTN: AFKC-RRB-OP Presidio of San Francisco, CA 94129
4	Commander US Army Combined Arms Center ATTN: ATZLCA-TM-T ATZLCA-TM-P ATZLCA-TM-A ATZLCA-LJ Fort Leavenworth, KS 66027	1	Commander US Army Forces Command ATTN: AFOP-TAS Ft. McPherson, GA 30330
1	Commander US Army Readiness Region I ATTN: AFKA-RR-AA Ft. Devens, MA 01433	1	Commander First US Army ATTN: Chemical Officer Fort George G. Meade, MD 20755
1	Commander US Army Readiness Region II ATTN: AFKA-RR-BRD Ft. Dix, NJ 08640	1	Commander XVIII Airborne Corps ATTN: AFZA-DPT-NC Ft. Bragg, NC 28307
1	Commander US Army Readiness Region III ATTN: NBC Officer Ft. George G. Meade, MD 20755	2	Commander III Corps ATTN: Corps Surgeon Assistant G3-Chemical Ft. Hood, TX 76544
1	Commander US Army Readiness Region IV ATTN: AFKA-RR-DO Ft. Gillem, GA 30050	2	Commander 24th Infantry Division ATTN: Div Cml Officer Div Surgeon Ft. Stewart, GA 31313
		1	Commander 197th Infantry Brigade ATTN: AFVE-CM Ft. Benning, GA 31905

DISTRIBUTION LIST (CONT'D)

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	Commander US Army Signal School & Fort Gordon ATTN: ATZHCD-CS (CPT Hamilton) Fort Gordon, GA 30905	4	Commander/Director Chemical Systems Laboratory ATTN: DRDAR-CL DRDAR-CLY DRDAR-CLN DRDAR-CLW-P (H. L. Gotoff) APG-EA, Maryland 21010
1	Commander US Army Missile & Munitions Center & School ATTN: ATSK-TME (CPT Richards) Redstone Arsenal, AL 35809	3	Commander US Army Natick R&D Command ATTN: DRDNA-VR (LT M. S. Edwards) DRDNA-O DRDNA-VCA Natick, MA 01760
2	Director US Army TRADOC Systems Analysis Activity ATTN: ATAA-TCO ATAA-TGH (J. Aguilar) White Sands Missile Range, NM 88002	2	Commander US Army Foreign Science & Technology Center ATTN: DRXST-MT2 DRXST-MT3 220 Seventh Street, NE Charlottesville, VA 22901
1	Commander US Army Combat Developments Experimentation Command ATTN: ATEC-PL-PA (MAJ Kontrim) Fort Ord, CA 93941	2	Director US Army Human Engineering Laboratory ATTN: DRXSY-HEL DRXHE-IS (S. Jackson) APG, Maryland 21005
2	Commander Dugway Proving Ground ATTN: STEDP-MT-DA-S (Dr. D. Parker) Dugway, UT 84022	1	Commander US Army Logistics Center ATTN: ALTCL-CFT (MAJ Zeigler) Fort Lee, VA 23801
3	Commander US Army Tropic Test Center ATTN: STETC-TD STETC-MTD-A (Dr. M. Elliott) Chemical Test Ofc (CPT Lushbough) APO, Miami, FL 34004	1	USAF Tactical Air Weapons Command/ THLO ATTN: MAJ Bambini Eglin AFB, FL 32542
1	Commander US Army Foreign Science & Technology Center HEL Liaison Office ATTN: DRXHE-FI (L. Washer) 220 Seventh Street, NE Charlottesville, VA 22901		

DISTRIBUTION LIST (CONT'D)

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	Commander US Army Readiness Region V ATTN: AFKB-RR-A-NBC Ft. Sheridan, IL 60037	2	Commander 3rd Armored Cavalry Regiment ATTN: Cml Officer Regimental Surgeon Ft. Bliss, TX 79906
1	Commander US Army Readiness Region VI ATTN: AFKB-RR-B-0 Fort Knox, KY 40121	1	Commander 194th Armored Brigade ATTN: Brigade Surgeon Ft. Knox, KY 40121
2	Commander 193rd Infantry Brigade ATTN: Cml Officer Brigade Surgeon APO, Miami, FL 34004	2	Commander 9th Infantry Division ATTN: Div Cml Officer Div Surgeon Ft. Lewis, WA 98431
2	Commander 82nd Airborne Division ATTN: Div Cml Section Div Surgeon Ft. Bragg, NC 28307	2	Commander 2nd Armored Division ATTN: Div Cml Officer Div Surgeon Ft. Hood, TX 76545
2	Commander 101st Airborne Division (AASLT) ATTN: Cml Officer Div Surgeon Fort Campbell, KY 42223	2	Commander 1st Cavalry Division ATTN: Div Cml Officer Div Surgeon Ft. Hood, TX 76545
1	Commander III Corps Artillery ATTN: AFVI-HB Fort Sill, OK 73503		
1	Commander 25th Infantry Division ATTN: Cml Officer Schofield Barracks, HI 96557	1	Commander 11th Air Defense Artillery Group ATTN: AFVJ-B Ft. Bliss, TX 79906
1	Commander 194th Armored Brigade ATTN: AFVL-S Ft. Knox, KY 40121	1	Commander Fifth US Army ATTN: AFKB-OP-N Ft. Sam Houston, TX 78234
1	Commander Sixth US Army ATTN: AFKC-OP-NBC Presidio of San Francisco, CA 94129	3	Commander 5th Infantry Division ATTN: Cml Officer - Arty Cml Officer - (M) DISCOM Div Surgeon Ft. Polk, LA 71459

DISTRIBUTION LIST (CONT'D)

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	Commander USA Logistic Assistance Office ATTN: Cml Officer APO, NY 09403	1	HQ SAC ATTN: DOTUD Offutt AFB, NE 68113
1	Commander 8th Logistical Command ATTN: Cml Officer APO, NY 09019	1	Defense Intelligence Agency ATTN: DTIA Washington, DC 20301
1	Commander 3rd COSCOM APO, NY 09757	1	Department of Navy Office of Deputy Chief of Staff for Naval Operations (Surface Warfare) ATTN: OP-37G Washington, DC 20350
		1	Naval War College ATTN: O06 Newport, RI 02840
1	Commander US Army Readiness Command ATTN: Director of Plans & Training MacDill AFB, FL 33608	1	Commander Wright Patterson Air Force Base ATTN: ASD/AELD Wright Patterson AFB, OH 45433
2	Commander US Army Mobility Equipment R&D Command ATTN: DRDME- DRDME-U Ft. Belvoir, VA 22060	1	Chief US Army Readiness Group ATTN: AFKB-RR-C-C-SP Fort Sill, OK 73503
1	Commander US Army Logistics Evaluation Agency ATTN: DALO-LEI New Cumberland, PA 17070	1	Commander US Army Infantry Center Chief, Planning Branch ATTN: ATZB-DPT-PO-NC Ft. Benning, GA 31905
1	Commander US Army Medical Intelligence and Information Agency ATTN: SGMI-ZA Ft. Detrick, MD 21701	1	Commander-in-Chief, Pacific Research & Analysis Office J77, Box 13 Camp H.M. Smith, HI 96895
1	Commander USAJFKCENMA ATTN: Surgeon Ft. Bragg, NC 28307	1	Commander US Army Armament Research and Development Command ATTN: DRDAR-SEA Dover, NJ 07801
		2	Commander US Army Aviation Research and Development Command ATTN: DRDAV-PC DRDAV-B St. Louis, MO 63166

DISTRIBUTION LIST (CONT'D)

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
2	Commander 7th Infantry Division ATTN: Cml Oficer Div Surgeon Ft. Ord, CA 93941	1	Commander 4th Brigade, 4th Infantry Division (MECH) ATTN: Cml Ofcr APO, NY 09358
1	Commander Eighth US Army ATTN: Cml Ofcr APO, SF, CA 96301	1	Commander 32nd Air Defense Command ATTN: Cml officer APO, NY 09175
2	Commander 4th Infantry Division (Mech) ATTN: Cml Ofcr Div Surgeon Fort Carson, CO 80913	2	Commander 2nd Infantry Division ATTN: Div Cml Ofcr Div Surgeon APO, SF, CA 96224
1	Commander 172nd Infantry Brigade ATTN: Cml Ofcr Ft. Richardson, AK 99405	1	Commander VII Corps ATTN: Asst. G-3 Chemical APO, NY 09197
1	Commander US Army Europe & Seventh Army (AEAFPC-NG-S&R) Deputy Chief of Staff, Opns APO NY 09403	1	Commander I Corps (KOR/US) Group ATTN: Corps Cml Ofcr APO, SF, CA 96358
1	Commander US Army Research & Standardi- zation Group (Europe) Box 65 APO, NY 09510	1	Commander 267th Chemical Co. ATTN: Cml Ofcr APO, SF, CA 96305
2	Commander 3rd Armored Division ATTN: Div Cml Officer Div Surgeon APO, NY 09039	1	Commander 19th Support Group (LOG) ATTN: Cml Ofcr APO, SF, CA 96212
1	Commander V Corps Artillery ATTN: Asst. G3-Chemical APO, NY 09757	1	Commander 266th Chemical Det. APO, NY 09281
2	Commander VII Corps Artillery ATTN: Asst. G3-Chemical Corp Surgeon APO, NY 09107	1	Commander HSEUCOH ATTN: EC35-0 APO, NY 09128

DISTRIBUTION LIST (CONT'D)

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	Commander US Army Okinawa ATTN: Cml Officer APO, San Francisco, CA 96331	2	Commander 8th Infantry Division ATTN: Cml Officer Div Surgeon APO, NY 09111
1	Commander US Army Japan ATTN: Cml Officer APO, San Francisco, CA 96443	1	Commander Southern European Task Force ATTN: Cml Officer APO, NY 09168
1	Commander US Army Advisory Group - Korea ATTN: Cml Officer APO, San Francisco, CA 96302	1	Commander 21st Support Command ATTN: Cml Officer APO, NY 09325
1	Commander HHC, V Corps ATTN: Corps Surgeon APO, NY 09079	1	Commander 7th Army Training Center ATTN: Cml Officer APO, NY 09114
1	Commander 1st Infantry Division (FWD) ATTN: Cml Officer APO, NY 09137	1	Commander US Command Berlin ATTN: Cml Officer APO, NY 09742
1	Commander 2nd Armored Cavalry Regiment ATTN: Cml Officer APO, NY 09093	1	Commander 27th Chemical Detachment APO, NY 09169
2	Commander 1st Armored Division ATTN: Div Surgeon Div Cml Officer APO, NY 09326	1	Commander Berlin Brigade ATTN: Cml Officer APO, NY 09742
1	Commander 3rd Armored Division, MMC (LOG) ATTN: Cml Officer APO, NY 09710	1	Commander 11th Armored Cavalry Regiment ATTN: Cml Officer APO, NY 09146
2	Commander 3rd Infantry Division ATTN: Div Cml Officer Div Surgeon APO, NY 09031	1	Director US Marine Corps Development & Evaluation Command ATTN: DELVETR-FPD Quantico, VA 22134
1	Commander USA Medical Command Europe ATTN: Cml Officer APO, NY 09180	1	Commander Naval Surface Weapons Center ATTN: G592 Dahlgren, VA 22448

DISTRIBUTION LIST (CONT'D)

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	Commander US Army Operational Test and Evaluation Agency ATTN: CSTE-PON 5600 Columbia Pike Falls Church, VA 22041	1	Commander Rocky Mountain Arsenal ATTN: SARRM-F-E Commerce City, CO 80022
1	Commander US Army Troop Support & Aviation Materiel Readiness Command ATTN: DRSTS-BA 4300 Goodfellow Blvd. St. Louis, MO 63120	1	Commander US Army Missile Command ATTN: DRSMI-DS Redstone Arsenal, AL 35809
1	Commander Development Training (NBC Section) ATTN: ATZK-DPR-PO-C Fort Knox, KY 40121	1	Commander US Army Communications Research and Development Command ATTN: DRDCO-SA Fort Monmouth, NJ 07703
1	Commander US Army Training Support Center ATTN: ATTSC-CS-OPA Fort Eustis, VA 2360	2	Commander Defense Technical Information Center ATTN: TCA Cameron Station Alexandria, VA 22314
1	Commander US Army Concepts Analysis Agency ATTN: CSCA-RQN (Dr. Ling) 8120 Woodmont Avenue Bethesda, MD 20014	1	Institute for Defense Analyses ATTN: Alan Rolfe 400 Army-Navy Drive Arlington, VA 22202
1	US Army HEL ATTN: R. N. Armstrong Box 716 Fort Rucker, AL 36362	1	Commander USAARMC ATTN: ATZK-CD-SD (Hilkemeyer) Fort Knox, KY 40121